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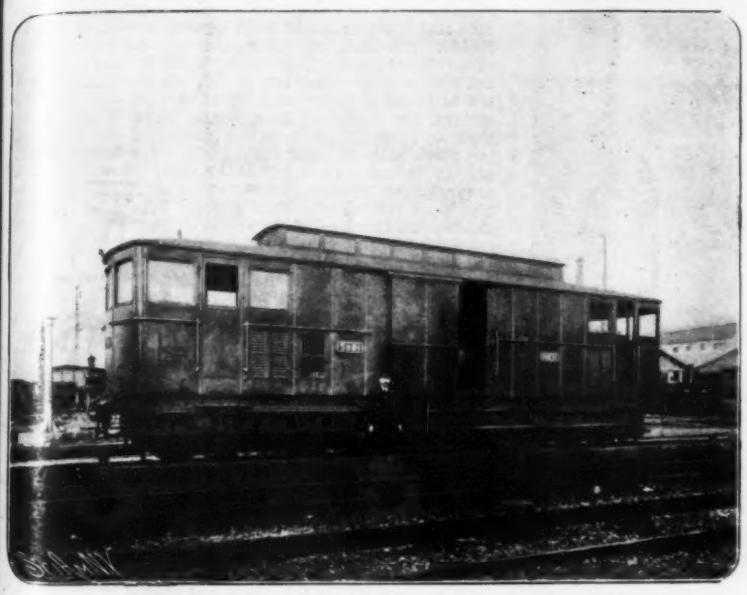
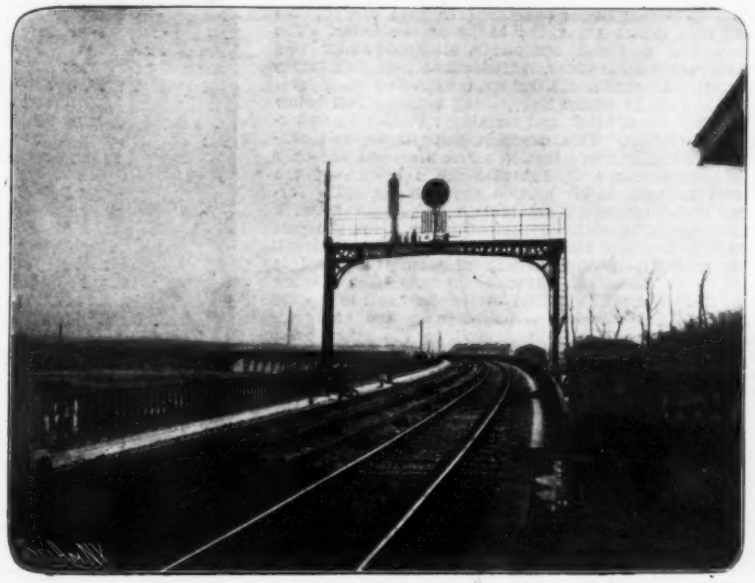
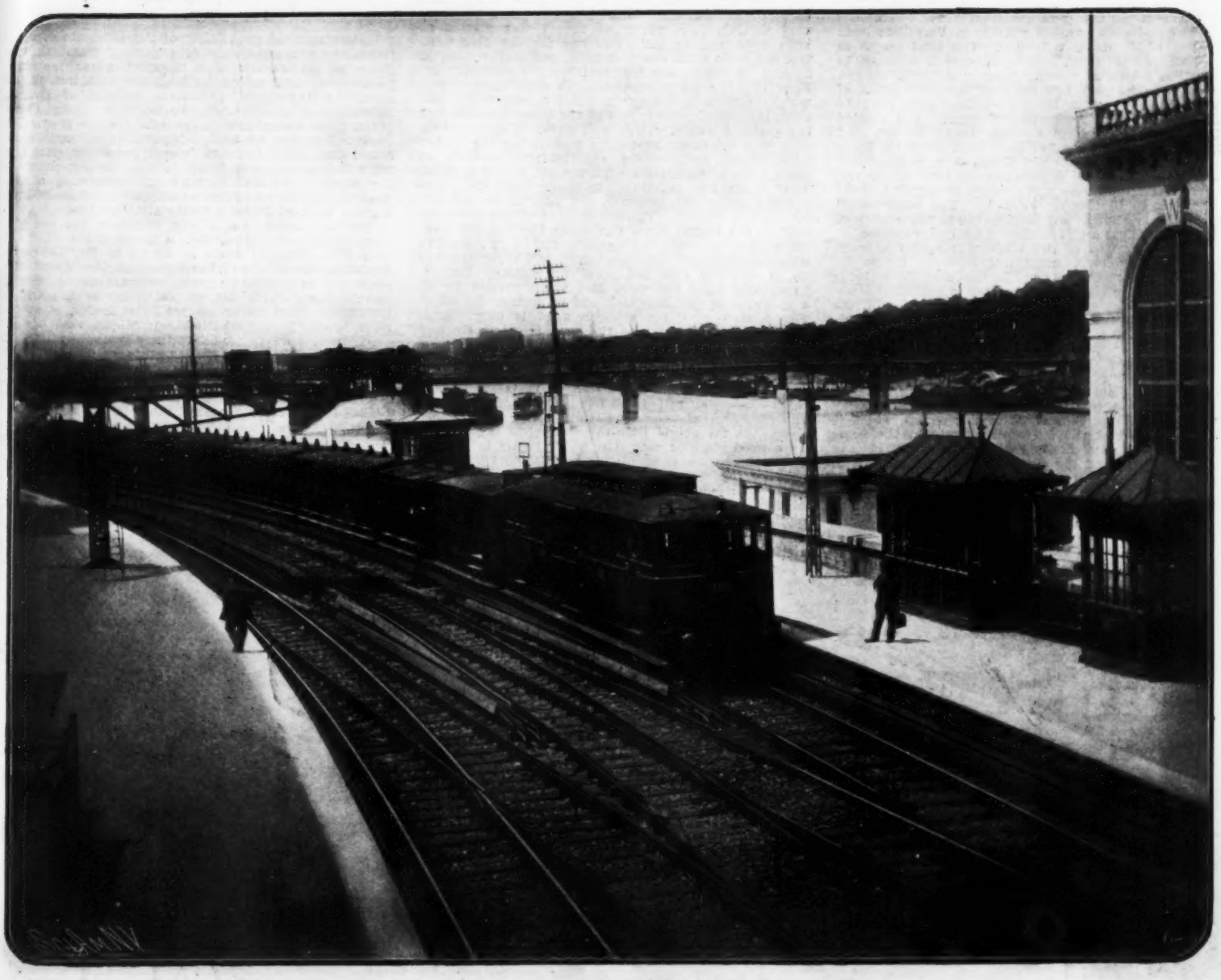


ELECTRIC LOCOMOTIVE OF THE PARIS-VERSAILLES ROAD.



THE ROAD AT ISSY STATION, SHOWING THE VIADUCT.



LOCOMOTIVE AND TRAIN ON THE PARIS-VERSAILLES ROAD, SHOWING STATION AT CHAMP DE MARS.

THE PARIS-VERSAILLES ROAD.

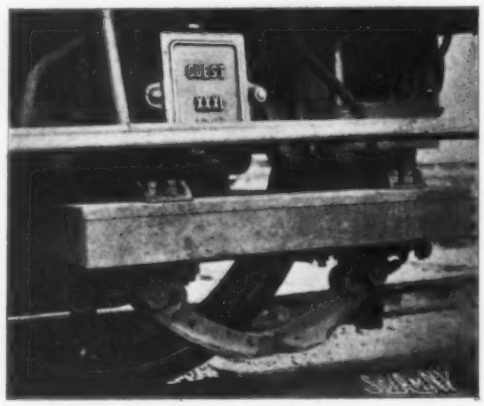
NEW ELECTRIC RAILROAD FROM PARIS TO VERSAILLES.

By the PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

THE new electric railroad which connects Paris with Versailles presents many interesting features, owing to the engineering work of the road as well as the use of electric locomotives to draw trains made up of railway cars. The line is designed to take off part of the overcrowded traffic of the Western Railway which passes by Versailles, on which it was found impossible to increase the number of tracks, and it was decided to construct a new line which should have a more direct route, besides having its terminal station on the banks of the Seine and thus nearer the center of the city. The new line is to take a part of the traffic of the main lines of Brittany and Normandy, as well as a large suburban traffic which will no doubt be increased owing to the centrally-located depot.

The construction of the part of the road which lies within the city limits has been rendered easy by the fact that it lies along the banks of the Seine. The main city terminal station is situated under the Esplanade des Invalides, the wide avenue which passes over the Alexander III. bridge, and it lies on a level with the banks of the river, being some 15 feet below the main street level, and forming virtually an underground station. This depot is quite large, and contains fifteen or more tracks which are used not only for the electric road, but also for a branch of the steam railway which crosses the Seine a little further on. The tracks are laid in pairs, and between each pair is an elevated cement footway for the passengers, to allow them to enter the cars on a level. The roofing is formed mainly of glass tiling and is upheld by ornamental iron columns. After leaving the station the line follows along the bank in double track, being protected on one side by the high embankment wall of the Seine and on the other by a wall which separates it from the river. The road is thus below the street level, and at the different bridges the street is laid over it upon short arches. At the Champ-de-Mars a number of side tracks lead to the main yards of the company, where are located the erecting and repair shops, and also one of the substations. Up to a point 1,200 feet outside the fortifications, the electric and the steam railroads have the tracks in common, but after this point the electric road branches off to the left, leaving the Seine and crossing the plain of Issy. The line traverses the plain upon a series of embankments and viaducts, passing under the viaduct of the Montparnasse-Versailles railroad and continuing to the Meudon tunnel, which is one of the important constructions of the line and is over two miles in length. After passing the tunnel, the road rejoins the tracks of the Montparnasse-Versailles railroad and runs parallel with it to Versailles upon a series of slight embankments. The total length of the line is 10.5 miles, which makes the distance to Versailles somewhat shorter than by the other routes, which are 11.1 and 13.8 miles. The long series of viaducts winding along the plain of Issy gives the road a unique and rather picturesque aspect. The viaduct construction was decided upon owing to the fact that the ground was either built upon or would be in the future, and the viaduct would occupy less space than an embankment, and besides the local authorities objected to the obstacle which would be afforded to the view by a continuous embankment. The latter would have been difficult in any case, owing to the quality of the soil, which is a plastic clay of a slippery nature.

The construction of the viaduct presented unusual difficulty owing to the nature of the soil. Below the clay lies a bed of chalk, and in this a series of large galleries was formerly dug in order to extract the material; the galleries measure as high as 13 by 16 feet section in some places, and there are often four galleries superposed. These galleries had to be either filled up after consolidating the walls or provided with a masonry vaulting. It was necessary to carry the foundations of the viaducts down to a considerable depth before reaching the solid bed, and in some cases this reached 50 feet in depth. Another difficulty lay in the presence of quicksands in this region, which is in fact formed of alluvial sands brought by the Seine at prehistoric epochs. As part of the excavation lay below the level of the river, fine sand charged with water was encountered, which was a great hindrance to the work. Under these conditions the viaducts have a somewhat unusual construction, since the lower third of the pillars is buried below the level of the ground. The road from Issy to Meudon is thus almost entirely formed of viaducts united by short lengths of embankment, making five viaducts which have a total length of 4,900 feet and four embankments representing 2,450 feet. The highest fill is that at Issy, which varies between 36 and 55 feet. The first viaduct on the Paris side has three masonry arches, which a bridge truss 37 feet long joins to the remaining six arches. The height is here 35 feet, and the total length 670 feet. The arches are circular, and the viaduct is built on a curve of 2,100 feet radius. A short fill connects to the Issy viaduct, which has thirty arches of 40-foot opening and the total length of which, including a metallic span of 110 feet, is 1,800 feet. This portion is illustrated in the engravings. The third viaduct of four arches which have a 60-foot openipg and a height of 35 feet, is followed by the 1,370-foot Moulineaux sec-



CONTACT SHOE OF AN ELECTRIC LOCOMOTIVE OF THE PARIS-VERSAILLES ROAD.

tion, which has fourteen arches, connected by a high bridge span of 100 feet; while the last viaduct contains eleven arches of 40 and 75 feet opening, whose foundations go down as low as 50 feet below the ground. The road then passes to the Meudon tunnel upon an embankment.

The greatest difficulty which was encountered in the construction was the driving of the long tunnel beneath the woods of Meudon, a distance of 10,890 feet. The greater part of the strata composing the soil down to 150 or 200 feet depth consists of sand, and the base of the sand is water-bearing for a thickness of 50 or 60 feet, thus forming a quicksand which is very difficult to work. The tunnel was started at both ends, and on the Paris end for the first 6,000 feet but little sand was met with, and a revetment of 24 and 32 inches was sufficient for the vaulting, but after this the water-bearing sands were encountered, which made it necessary to use a vaulting 4½ feet thick in some places. It was on the Versailles side that the greatest difficulty was met with. The semi-fluid sand was not easily kept from penetrating the timber construction, and, besides, this material swelled up when brought in contact with the air, exerting an almost irresistible pressure. In some cases the stone cracked under the pressure and had to be replaced by Alençon granite. Toward the end of the work the roof of the tunnel gave way when the timbers were removed to construct the masonry, and let in a flood of water-bearing sand, and the tunnel had to be dammed up to stop the flow and prevent a greater disaster. From this point the work had to be carried on by a special construction which will be further described. The density of the aquiferous sand is only double that of water, or 1.9, and the sand is extremely fine, so that it passes through the joints and fissures almost as easily as water, thus making the construction of the timber supports especially difficult.

The current for the locomotives is taken from a third conducting rail which lies outside the main rails and is supported upon insulating blocks of paraffined wood. At the points near the stations it is protected by a wood piece on each side, which partly incloses it. The trains are made up of the standard cars which are used on the Western railway, and are drawn by specially built electric locomotives. These are of two distinct types, the first of which may be called a locomotive proper, while the second is a motor car which resembles the type used on the Metropolitan. The locomotives proper were designed for a train of 100 tons at a speed of 28 miles an hour upon a 1 per cent grade, but in fact can draw a 140-ton train at 33 miles an hour. These locomotives (one of which is illustrated) were built by the Société des Locomotives Electriques, and are mounted on two double-axle trucks. At each end is a cab which contains the various controlling devices, while the remaining space in the middle is utilized to contain baggage and will hold a 6-ton load. The total length of the locomotives is 43 feet. They are equipped with four motors, one upon each axle. The motors can be coupled in series-parallel or all four in parallel. Of the ten locomotives which have been built, there are two different types, the exterior appearance of which is the same, but which differ in the form and disposition of the motors. Four of the locomotives are equipped with single-reduction motors of the Postal-Vinay type, with electric coupling, and the six others are directly connected to the driving axle, also through a spring coupling. Of the direct driving motors one-half are of the Westinghouse pattern and the remainder from Brown, Boveri, & Co., of Baden. These motors are similar in appearance, being of octagonal shape; they are built for 125 horse power, but may be pushed as high as 200. The method of elastic coupling assures easy running. In the gearless motors the armature is mounted on a hollow steel shaft of large diameter, in the interior of which passes the main axle carrying the wheels. The hollow shaft carries at one end a trianguar steel plate to which are attached springs which are also fixed to three points of the wheel. The springs thus take up the shocks. In the case of the reduction motors the elastic coupling has the same disposition, but the armature is placed as in a tramway car, and instead of being mounted directly on the hollow shaft, it drives the latter by gearing. The hollow shaft is supported in bearings which are cast with the motor body, and through the shaft passes the car axle as before. The company is also making trial of several motor cars of the Metropolitan type, which are equipped with Sprague or Thomson-Houston outfits. The locomotives have four rubbing contacts which are formed of two articulated steel pieces pressed on the rail by springs. The current is supplied by the large Moulineaux station, which delivers 3-phase current at 5,000 volts to the sub-stations along the route, where the potential is lowered to 550 volts direct current by rotary converters.

[Continued from SUPPLEMENT No. 1430, page 22903.]

ON ELECTRONS.*

By SIR OLIVER LODGE, F. R. S., Vice-President.

PART IV

THE ELECTRON THEORY OF CONDUCTION AND OF RADIATION.

MEANWHILE the probability of the existence of electrons and the possibility of regarding them as the basis of all electric and of most other material phenomena, had seized hold of the imagination of several mathematical physicists, notably of Dr. J. Larmor and of Prof. H. A. Lorentz. Both these philosophers endeavored to trace all electric properties to the behavior of electrons, usually of course in association with material atoms; and Dr. Larmor proceeded to try and invent a possible structure in the ether which should have the properties of an electron, whether positive or negative, and so reduce a great part of Physics to its simplest terms. This magnificent attempt at a new Principia has not yet been finally successful, but a great mass of very suggestive material is to be found in Dr. Larmor's contributions to the Transactions of the Royal Society, and in his recent great summary called "Ether and Matter"; which last, published by the Cambridge University Press as an Adams Prize Essay, is accessible, though barely intelligible, to all.

Suffice it here to say that the electron constitutes the basis of the whole treatment, and that there is supposed to be no electric current except electrons in motion. They may move with the atoms, as in electrolysis; they may fly alone, as in gases; or they may be handed on from one fixed atom to the next, as in solids.

CONDUCTION.

The possible modes of conduction or transmission of electricity are in fact three, which I may call

* Excerpt from a paper read before the Institution of Electrical Engineers and published in the Journal of Proceedings of the Institution.

THE VIADUCT AT ISSY.

THE MEUDON TUNNEL.

respectively the bird-seed method, the bullet method, and the fire-bucket method.

The bird-seed method is adopted in liquids: it is exemplified in electrolysis; the bird carries the seed with it, and only drops it when it reaches an electrode.

The bullet method is the method in gases, as has been clearly realized by aid of the cathode rays; the space from cathode to anode represents the length between the breech and the muzzle of the gun, and the rest of the path is analogous to the trajectory of a bullet, which ultimately either penetrates or is stopped by a target, with a flash of light or other appropriate disturbance.

The fire-bucket method must be the method of conduction in solids, where the atoms are not susceptible of locomotion and can only pass electrons on from hand to hand; oscillating a little in one direction to receive them, and in another direction to deliver them up, and so getting thrown gradually into the state of vibration, which we call heat. But it may be observed that this need for motion, in order to pass electrons on, becomes less and less according as the body is subject to the irregular molecular disturbance we call heat. It may be the expansion and molecular separation, or it may be the irregular jostling and disturbance, that impede easy conduction; but certainly conduction improves as temperature falls, and transmission becomes quite easy at very low temperatures. The conduction of heterogeneous alloys is a less simple matter, being probably mixed up with back E. M. F. developed at innumerable junctions, otherwise it would be instructive to examine the effect of low temperature on the conductivity of a metal which did not contract with cold. The extra conductivity of hot electrolytes is a totally different phenomenon: it is not true conduction, but convective locomotion of ions in their case.

Metals are bodies in which the transfer of an electron from one atom to another is easy, demanding no force as long as the process is not hurried—a process of the nature of a *diffusion;* insulators are bodies in which it can only be accomplished with violence. The transmission of vibrations along a chain of connected molecules may well occur through a not dissimilar kind of connection; and hence the conduction of electricity and the conduction of heat, though really different processes, may have many points in common.

Most is known about electrolytic and gaseous conduction. In gaseous conduction the negative electrons fly free and fast; the positive charges travel slowly by reason of their association with matter.

In liquid conduction both sets of electrons are associated with atoms, and travel only as ions at a slow diffusion rate which was calculated by Kohlrausch, has been observed by myself and others, and is well known.

The rate of transmission in solids can only be inferred, and it would appear as if in one class of solids the positive were able to travel fastest, whereas in another class negative traveled fastest: a difference which is familiar in liquids. In acids, for instance, the positive charges travel much the quickest, because they are associated with light hydrogen atoms; and it is owing to the comparatively easy migration of this light or small hydrogen atom that acids are in general such good conductors.

The Hall magnetic bend, like Faraday's magnetic rotation, is a differential effect, and would be zero if positive and negative were equally acted on. In gases it is differential too, but there the negative charges are so free as compared with the positive, and fly so much more rapidly, that the Hall effect in gases, especially in rarefied gases, is very great in comparison with the small residual effects found in liquids and solids.

RADIATION.

But it is not only the progressive motion or locomotion of the electric atomic appendages that we have to consider; we must assume also that they are susceptible of motion in the atom itself, either vibrating like the bead of a kaleidophone, or revolving in a minute orbit like an atomic satellite. Indeed it is to the vibrations or revolutions of the electrons in an atom that its radiating power is due. Matter alone has no perceptible connection with the ether, a fact which is proved in my paper in the Philosophical Transactions for 1893 and 1897; it is electric charge which gives it any connection, and even then it has no *viscous* connection—there is no connection that depends upon velocity, or is of the nature of friction—it is purely accelerative connection; it is only when the charge vibrates, and during its accelerative periods, that it is able to influence the ether and carve it into waves—waves consisting probably of alternations of shear, with no motion of the ether as a whole, but only a to-and-fro quiver of its equal opposite constituents over some excessively small amplitude: a kind of motion which constitutes what we know as radiation. It is not the atom pulsating as a whole which disturbs the ether, but the pulsations or vibrations, or the startings and stoppings and revolutions, of its electric charge. But normal or centripetal acceleration, involving nothing more than change of direction, is just as effective as actual change of speed. If an electric charge is able to describe a small orbit four hundred billion times a second, it will emit the lowest kind of visible red light. If it vibrates faster it will emit light of higher refrangibility; and the particular kind of radiation emitted by the atom of any substance, when in a fairly free state, will depend on the orbital period of its electrons: every frequency of vibration corresponding to a definite line in the spectrum.

But, if this be so, radiation must be susceptible to magnetic influence, for a revolving electric charge constitutes a circular current, and if a magnetic field is started into existence with its lines threading that circuit, it must, while it is changing in intensity, cause the speed either to increase or to decrease, and so will either raise or lower the refrangibility. If, then, electrons are revolving in every direction and a magnetic field is excited, during the rise of the field the pace of some will be increased and of some decreased, and this increase or decrease will not stop until the magnetic field is destroyed again.

Hence it would appear that if a source of radiation is put into a magnetic field, and its lines examined with a spectroscope, they should be doubled, some being raised in refrangibility, others lowered; or if any are left unaltered the line might be tripled, or if the motion was of a more complicated character the line might conceivably be quadrupled or sextupled, or any other change produced according to the character and complexity of the motion. At any rate it would seem that the line must be affected somehow, even if it were only broadened. It happened, however, that when Dr. Larmor theoretically perceived this, and did the calculation for it in 1895 to see how much effect might be expected, he made the natural assumption not that an electron could move by itself on a comparatively stationary atom, as above described, but that the atom was itself pulsating or revolving or quivering in some way as a whole and carrying its charge with it. On this assumption, knowing what he did about the massiveness of an atom, he perceived that the effect would be too small to see; and inasmuch as Faraday had, with imperfect appliances many years ago, looked for some such effect—not then guided by theory, but simply with the object of trying all manner of experiments—and had failed to see anything, no fresh experimental attempt to examine the question was initiated; nor was the matter publicly referred to until, as hinted above, Zeeman of Amsterdam, in 1897, with a powerful Rowland grating and a strong electromagnet, skillfully observed a minute effect consisting in a broadening of the lines emitted by a sodium flame placed between its poles; and then at once Dr. Larmor wrote to me, saying that this must be the effect which he had expected, but thought must be too small to see. On receiving the intimation I immediately, with a little trouble, repeated and verified the experiment, and exhibited it at the Royal Society soirée in May that same year.

From this simple but important beginning the large subject of the influence of a magnetic field on the radiation from different substances has been laboriously worked at; not only by the original discoverer, but by Preston in Dublin, Michelson in America, and others; and a whole series of important facts has been made out. Every line has been studied separately; some lines are quadrupled, some tripled, some sextupled, and so on, as said above. One mercury line is resolved into as many as eleven components. The effect is therefore *not* too small to see, though it needs excessively high power and perfect appliances to see it; and so it became evident that if radiation were due to moving electrons, their motion could not be handicapped by having very much matter associated and moving with them. It became possible, indeed, by making a measurement of the amount of doubling undergone by the lines in a given field, to ascertain how much matter was associated with the revolving electric charge in any given case; in other words, to make a determination of the electro-chemical equivalent effective in radiation, i. e., of the ratio m/e. Indeed, Prof. Zeeman, with considerable skill, made a rough determination of this kind at a very early stage, when he only saw the effect as a slight broadening of the sodium lines; and came to the conclusion that the electrochemical equivalent was quite different from that appropriate to electrolysis, being some thousand times smaller. He found, in fact, that the ratio e/m had in this case also the notable value already suspected in connection with cathode rays, viz., the value 10^7 c.g.s.

More recent measurements have confirmed this estimate, and shown that the ratio of charge to matter in the Zeeman case is practically identical with the ratio of charge to matter in the cathode ray case; in other words, that whatever is flying in the cathode rays is vibrating in a source of radiation, and that if the cathode rays consist of moving electrons, radiation is due to vibrating or revolving electrons.

Even this, however, does not constitute a proof of the existence of masses so much less than atoms; it may be only a remarkable coincidence. Besides, it is possible that in all these cases the whole atom is, after all, moving, but that its electric charge is one thousand times bigger than what had previously been observed as the proper charge of an atom.

But this assumption, improbable even for the cathode rays, becomes still more unlikely in the case of radiation, where it is not at all unnatural that only a very small part of the atom should be moving, the great bulk of it being practically stationary. Besides, the more the details of the Zeeman effect are studied, the clearer it becomes that the electron theory attributed to it from the first by Prof. H. A. Lorentz, as well as by Fitzgerald and Larmor in England, is complete and satisfactory.

ON THE ELECTRON THEORY OF THE MAGNETIZATION OF LIGHT.

Among the early contributions that have been made to the theory of moving charges, few are more remarkable than those of Dr. Johnstone Stoney in connection with the process of radiation, long before there had been any experimental verification of the separate existence of these electrons, or of the fact that the emission of light from a substance is due to their motion. Dr. Stoney had treated them in an astronomical manner, in 1891, dealing with an electron moving round an atom as if it were a satellite moving round a planet, and had discussed the various perturbations to which they might be subject, and the effect of those perturbations on the spectrum of the light emitted.

One of the simplest kinds of perturbation is what is called a progression or recession of the apses, being a slow revolution of the orbit in its own plane. Such a motion was shown to be able to account for a doublet in the spectrum; for of the two component vibrations into which the motion can be analyzed, one has been made more rapid and therefore its light raised in refrangibility, the other has been made slower and therefore lowered in refrangibility.

Another closely allied kind of perturbation, analogous to precession of the equinoxes in the case of the earth, would result in a line triplet in the spectrum. This precessional motion occurs in an orbit subject to any oblique pull or deflecting force. Instead of yielding directly to that pull, its effect is to make the axis describe a kind of cone, the kind of motion that one sees in an inclined spinning-top: the pull of gravity on a spinning-top does not make it topple over, but makes it precess. So also with a hoop or bicycle when not vertical: instead of tumbling, it turns round and round in a circuit as long as its motion continues; only falling when the motion ceases. Hence if the orbit of an electron were subjected to an oblique or deflecting force, the effect would be not to place it directly in the desired position perpendicular to a line of force, but to cause it to precess; and this motion might be analyzed into three, the acceleration and retardation of circular orbit above mentioned, which would result in a doubling of the line, and a third component, viz., the one parallel to the axis, which would be unchanged, and would therefore represent a spectral line in its old position, the center of the group of three. All this was clearly perceived by Larmor and Fitzgerald in connection with Dr. Zeeman's discovery, though they were anticipated by his great compatriot the eminent physicist, H. A. Lorentz, to whom the most complete publication of the theory is due, being in several respects anticipatory of the experimental results. For it may be observed that the light emitted by the oscillation components above spoken of will be all of one definite kind, due to vibrations in one definite direction and therefore polarized. The kind of polarization would depend on the aspect from which it was seen. If seen at right angles to the axis of precession, all three lines should be plane polarized, the middle line at right angles to the other two. If, however, it be looked at along the axis of precession, then there should be no middle line, because the axial vibration would then be end on; and the two side lines should be circularly polarized.

Directly Zeeman had demonstrated the fact that a magnetic field applied to a source of light was able to act as a perceptible perturbing cause, Professor Lorentz was at once able to predict the whole of that which has been here stated about the tripling of the line seen sideways to the lines of force, and the doubling of the line seen endways, with all the polarizations as just stated; because the lines of magnetic force constitute the precessional axis. And all these effects were shortly afterward seen by Zeeman and others, and are characteristic of the simplest circular orbit.

At first sight one might be inclined to suppose that the orbits would all face round and set themselves normal to the lines of force, like so many circular currents; but that is to forget the inertia of the traveling electron. It is manifest that since a revolving electron constitutes a circular current, its *tendency* will be to set itself with its plane normal to the lines of force; but since by hypothesis the revolving electron has inertia, the current will not so set itself, but will yield to the deflecting force in an indirect manner as a top does; or as the oblate spinning earth does—as explained by Newton in the Principia—the axis of rotation having a conical motion round the lines of force, the motion which is called the precession of the equinoxes in the case of the earth, and the Zeeman effect in the case of a radiating atom.

This is an account of the chief part of the Zeeman effect, and may be regarded as the most fundamental kind of disturbance caused by a magnetic field on a source of radiation. But there may be other minor disturbances, just as in the case of the earth, whose axis is not only subject to precession, but also to nutation—a nodding movement superposed upon the main motion. It is also quite possible for the middle line, or for the two outer lines, or indeed for all three lines to be doubled; thus giving rise not to the standard triplet, but to a quartet or a quintet or even a sextet—appearances seen and photographed for some lines of some substances by Preston.

Even the two constituents of the double sodium line behave differently: one of the sodium lines, D_2, which had appeared only broadened to Zeeman at first, really becomes a sextet. The other sodium or D_1 line becomes a quartet; and a complete study of the behavior under magnetism of all the lines and groups of lines given by different substances must result in a great extension of our knowledge in many directions; in fact it is hardly too much to say that the discovery of Zeeman, in the light of the theory of Lorentz, has doubled the power of spectrum analysis to throw light upon the processes of radiation and the properties of atoms, and has opened up a new department, as it were, of atomic astronomy, with atoms and electrons instead of planets and satellites.

(To be continued.)

CONTEMPORARY ELECTRICAL SCIENCE.*

MOTION THROUGH THE ETHER.—Lord Rayleigh discusses the question: Does motion through the ether cause double refraction? He answers it in the negative. The question was suggested by Fitzgerald's and Lorentz's supposition that motion through the ether alters the relative dimensions of bodies. Such a change of dimensions might naturally be accompanied by a sensible double refraction, and as the beginning of double refraction can be tested with extraordinary delicacy, the author thought that even a small chance of arriving at a positive result justified a careful experiment. The experiment was made with an apparatus consisting of a tube containing a liquid and mounted in a north and south direction at noon. At that time, the motion of the surface of the earth is across the ether, and a beam of limelight may be used to detect any double refraction. The tube was mounted on a board which could be swung round into the east-west direction. Observations made upon bisulphide of carbon in a tube 76 cm. long failed to indicate the slightest shift of the band on rotating the board either at noon or at 6 P. M. Tests of a solid consisting of separate pieces of plate glass, to avoid double refraction due to internal strain, were equally negative. The delicacy of the apparatus was such as to show 10^{-6} of the single refraction.—Lord Rayleigh, Phil. Mag., December, 1902.

IONIZATION OF SALT VAPOR.—At a constant temperature, the conductivity of an alkaline salt flame depends upon the E. M. F., upon the distance between the electrodes plunged into the flame and upon the concentration of the solution. If the E. M. F. alone varies, the conductivity, at first proportional to the E. M. F., tends toward a saturation value. G. Moreau has made some experiments to elucidate the mechan-

* Compiled by E. E. Fournier d'Albe in the Electrician.

ism of flame conduction. He introduced two small platinum condensers into a flame, gave a high charge to the lower one, and observed the conduction across the upper one. He found that this conduction was independent of the charge of the lower one, and hence concludes that the flame contains no free ions, since these would be absorbed by the lower condenser. In another experiment he mounts a salted flame between and in contact with two unsalted flames, in one of which an electrode is fixed. A movable electrode plunges into the other flames, and as soon as it touches the salted flame the conductivity goes up abruptly, to a great extent if the electrode is negative, and to a small extent if it is positive. This unipolar conductivity is analogous to that of a mass of hydrogen surrounding a carbon filament. The author believes that the presence of a metallic conductor is essential for ionizing a vapor.—G. Moreau, Comptes Rendus, November 24, 1902.

ON A NEW PROCESS FOR TUNING SPARK TELEGRAPH STATIONS.*

By COUNT ARCO.

IN the following reference will be made to high-frequency systems only. The simple laws of electric resonance will be taken for granted. In the first place will be shortly described the principal parts of the oscillating system. The sending and receiving conductors both consist of straight wires stretched vertically and earthed at their lower ends through inductance coils of a few windings. At the sending end, connection is made with the exciting circuit at some point of the inductance coil; at the receiving end, connection is made similarly with the indicating apparatus. The exciting circuit of the sending station consists of a high-tension condenser, which stores the exciter's energy, a spark-gap and a small amount of inductance. By the discharge of the condenser through the spark-gap, oscillations of determinate frequency are established whose proper period can be estimated from the inductance and capacity in the circuit. The indicating circuit at the receiving station is similarly made up of capacity and inductance, only there is used here more inductance and less capacity than in the corresponding sending circuit. The various connections between these parts will be further described below.

Resonance must be established between:

1. The exciting circuit of the sending air-wire.
2. The air-wires of the sender and receiver.
3. The receiver air-wire and the circuit containing the indicating apparatus.

Formerly the adjustments 1 were made somewhat

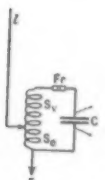


FIG. 1.

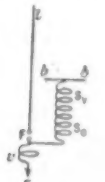


FIG. 2.

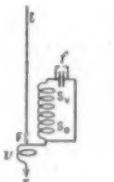


FIG. 3.

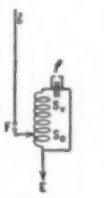


FIG. 4.

as follows: A hot-wire ammeter of range about 0.1 to 0.5 ampere, possessed of a shunt of variable inductance, was included in the air-wire as near as might be to the current loop. The frequency of the air-wire was then so altered that a maximum reading was obtained. In our own arrangement the capacity of the condenser in the exciter circuit is chosen of such magnitude that it is fully charged each time by the induction coil; and the frequency of the primary of the induction coil is so arranged that the secondary of the coil, together with the condenser, is in resonance with it.

The determination of resonance by finding the maximum at the current loop of the air-wire is prompted by practical considerations, for this current loop is always accessible. The potential loop is not so accessible in comparison. Moreover, determinations based on measurement of spark-length at a tension loop give merely an idea of the energy taken up by the air-wire, whereas the current measurement indicates the rate of radiation of energy, and this bears on the distance of propagation.†

The resonance of the receiving air-wire with the sending air-wire, and the mutual resonance of the

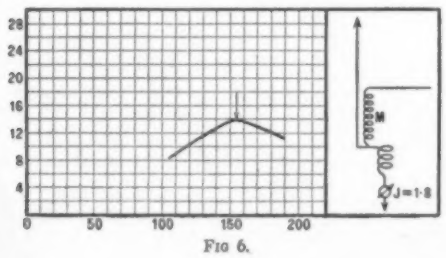


FIG 6.

parts of the receiving apparatus have hitherto offered great difficulties. A practical example will explain this. Suppose a coast station is already operating to several tuned ship stations, and that a new ship station is to be installed. The old method was to find by trial over a short distance the proper dimensions. But in the case of a fast passing vessel, there is not sufficient time for these careful trials, and tuning could only be effected with difficulty. The invention of a method for the predetermination of the receiver's period is thus of importance.

* Abstract from the Elektrotechnische Zeitschrift.

† Slaby, "Wissenschaftliche Grundlagen der Funkentelegraphie," Elektrotechnische Zeitschrift, 1902, p. 168; The Electrician, Vol. XLIX., pp. 6 and 46.

The characteristics of such a new method of tuning may be seen from some experiments carried out in 1901, when a single sender was used to tune by trial, as accurately as possible, three receiving stations with air-wires of different lengths. The disposition of the receiving apparatus is shown by Fig. 1. The indicating circuit contains *Fr* a coherer, *C* a condenser, *Se* the earth coil, *Sv* the branch coil, the air-wire *l* by

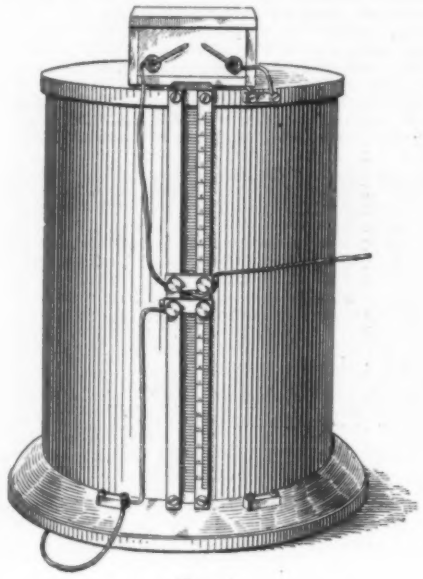


FIG. 5.

its place of attachment serving to define the two coils so named. The relay and a cell are connected in parallel with the condenser. The experiments at the three stations so fitted showed that *Se* was greatest where the air-wire was shortest.

Of course, the sum $Se + Sv$ remained always constant. The condenser *C* had a capacity of about 0.01 microfarad. Now, the product inductance and capacity in these tuned receiving circuits was about a

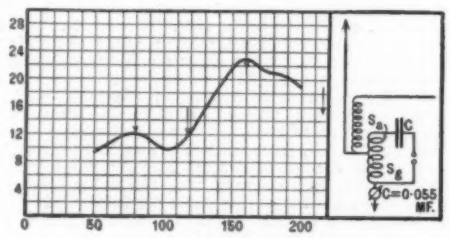


FIG. 7.

thousand times larger than the corresponding product at the sending station. This showed that the condenser *C* had no influence on the period, and indicated that the period was determined by the inductance in circuit together with the capacity of the coils and of the coherer. An uncohered coherer behaves, of course, as a condenser, and it becomes necessary to measure its capacity.

The sender used in the above experiments had attached to it, as in Fig. 2, an inductance of magnitude $Se + Sv$ as ascertained at the receiving station. A wire, *bb*, was connected to the upper end of the coil, and its length varied till the whole acted as a "multiplicator," when it is necessarily in resonance with the air-wire. The capacity of the wire *bb* must then correspond with that of the coherer previously associated with $Se + Sv$. The assumption is here made that the inductance of *bb* may be neglected in comparison with the large inductance of the coil. Thus the coherer capacity was found to be capable of representation by a wire 350 cm. long, 1 mm. diameter, placed about 1 meter from the earth.

Once the capacity of the coherer had been determined—the capacity of individual coherers of the

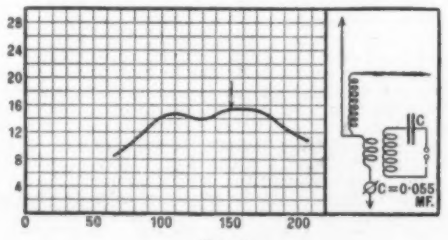


FIG. 8.

vacuous, wedge-gap type used differed very little—the wire capacity was replaced by a glass plate capacity in the apparatus, arranged as in Fig. 3. The dimensions of such a condenser were found to be: surface 14 sq. cm., distance between coatings 0.5 cm., specific inductive capacity of glass, about 7. The tuning of the coil and condenser circuit in Fig. 3 was effected by making spark-gap measurements at the micrometer spark-gap *f* while the self-induction $Se + Sv$ was varied. It is now possible to predetermine the time of the receivers intended for a certain sender. A circuit tuned as above, arrived at the receiving station, is attached to the air-wire as in Fig. 4. *Se* is varied till resonance is indicated by the micrometer-gap *f*. Then *Sv* and the air-wire are in harmony with the tuned closed circuit, already attuned to the distant sender. A practical form of receiving coil with coherer condenser is shown in Fig. 5. *Se* and *Sv* are varied by the slider contacts. In later forms the portion of the windings not in use are prevented from vibrating electrically by shortening.

More recently the condenser representing the capacity has been eliminated, and, once for all, a reduction factor has been settled upon by which the experimentally-determined number of windings is multiplied to obtain the number required when a coherer (or representative capacity) is in series. In normal cases this reduction factor has the value 0.54.

The method described above is due to myself, and has been worked into practical shape with the cooperation of Herrn Rendahl and Scheller, of the Allgemeine Elektricitäts-Gesellschaft. The method has already in numerous cases proved satisfactory.

Experiments on a large scale were carried out in the winter of 1901-2, between the Kabelwerk Oberspree, Ober-Schöneweide, and the Allegemeine Elektricitäts-Gesellschaft offices, 12.5 km. distant. The sending air-wire system at Ober-Schöneweide is suspended from a horizontal wire tied to the tops of two 70 meter (230 feet) chimneys 25 meters (82 feet) apart, and reaches a horizontal distance of 120 meters (394 feet) to the experimental room. The system consists of 10 air-wires, each 2 meters (6 feet) apart at the top, and each 140 meters (460 feet) long. Each air-wire is a bare copper 7 x 0.28 cable. Earthing was secured by attaching the wires to railway metals and to tubes driven into the subsoil. The system was electrically excited in various ways in turn and, by means of "multiplicators," the wave-length and tune ascertained. Values for the same quantities were found by tuning the other station by the method above described. In Figs. 6, 7, and 8 the results of experiments and the dispositions of apparatus are shown. The abscissæ represent *M* in meters, the ordinates the spark length at the upper end of the coil *M* in millimeters. The vertical arrows indicate the value of the wave-length found by tuning the receiving station by the method described. Figs. 7 and 8 show two maxima. In one case, the shorter wave has only half the amplitude of the longer wave. Quite feeble excitation was efficient in the disposition of Fig. 7, a spark-length of 1 mm. being reliable. This arrangement gives an intensity 30 per cent greater than that of Fig. 6. In the arrangement shown in Fig. 8 the inductances were so chosen as to make the circumstances of the air-wire comparable with those of the other cases. The maxima here lie closer together and are more nearly equal, and only the longer wave was detected by the receiver.

The explanation of the presence of the two maxima in Fig. 7 seems to be that the oscillations have two different paths to earth—namely, the way through the lower part of the inductance (*Sg*, five windings) or by the shorter way, including *Sa* (three windings), the condenser and the spark-gap. The first path gives rise to the longer wave-length, the second to the shorter. The maxima will, therefore, lie the farther apart the greater the difference between the effective lengths of the two paths. A similar phenomenon occurs in the case of Fig. 8 in consequence of the strong mutual electromagnetic reactions of the primary and secondary windings shown. These explanations have been proved correct by altering the magnitudes of the capacity and inductance appropriately. The two maxima can, in fact, be made to coincide by arranging the closed circuit symmetrically, and of such dimensions that the paths pointed out become equal.

HISTORY OF CHAIN TESTING.

IN an interesting address as President of the Institution of Mechanical Engineers, Mr. J. Hartley Wicksteed has pointed out that it was the substitution of iron cables for hempen ones that directly led to testing the strength of materials.

When the first chain cables for ships were made by Robert Flinn and Capt. Brown, they were found to be in every way superior to those of hemp, provided only that they were free from any single faulty link. From the first Capt. Brown was of opinion that there was nothing more essential in completing an iron cable than the most rigid attention to proving. In the year 1812 chain cables were made by Brown at Millwall, and he had a machine made for proving them "which, by enabling him to put as great strain upon the cables as was likely ever to be brought upon them when in use, thus detected any defective materials or insufficient workmanship." The firm of Brown & Lenox is still in possession of the original sketches made by Capt. Brown of his machine. It was a 100-ton machine, consisting of a long bed, at one end of which was a powerful double-geared crab turning a chain barrel. Two side-links wound round the barrel, stapled to the two outer ends and converging as they coiled up toward the center of the barrel and thus uniting to give a central pull on the shackle to which the test-chain was attached. At the other end of the bed there was a pair of compound levers having a ratio of 200 to 1. The levers had knife-edged main fulcra, but instead of having knife-edged load fulcra they had rounded butts on which the side-link chains were fixed, and from which they pulled at tangents, so that the fulcrum distances were the distances from the center lines of these chains to the knife-edged fulcra. The upper lever carried a scale pan for weights.

Brown not only used his proving machine to prove his chains, but he tested the mechanical properties of the iron of which he wished to make the chains, and by so doing gave an impetus to testing which was much required, and which did much to place the country on a better footing with reference to the quality of iron and chain cables. This was the starting of testing the strength of materials in a commercial sense, and in 1829 a 130-ton vertical testing machine was designed and built at Cyfarthfa Works, by Mr. William Williams, engineer to the works. With this machine Mr. Williams made experiments on riveted joints with single butt straps, and also upon iron bolts up to 2 inches square. This machine had hydraulic cylinders for straining the specimens

and knife-edged levers for measuring the stress. In the year 1831 the vessels of the Royal Navy were directed to be supplied with chain cables on a more extended scale, and the Admiralty ordered their first chain-testing machine from the firm of Messrs. Bramah, of Pimlico. The machine was finished in 183[illegible] and was started in regular work at Woolwich Dockyard in April, 1833. It was only as a result of all this careful testing that, in 1836, the underwriters ceased to charge a higher premium for vessels that had iron cables than for those that had hempen ones.

In the year 1846 the rules of Lloyd's Register were such that their surveyors were supposed to see that all new chains supplied to classed vessels were tested, and that the test applied was marked on each length. In 1853 the rules of Lloyd's Register made it imperative that, before a vessel could be classed, a certificate should be produced as to the test of the chain cables, and in 1860 the rule was extended to anchors. The use of testing machinery, originated for the purpose of proving chain cables, has been extended in many directions. Researches in the strength of materials of construction have been pursued by many of the ablest mechanical engineers in this country and abroad, and there still remains a field open for experiments, especially on the strength of full-sized structures. The French government are now putting down a machine in Paris which will test a strut or column 90 feet long and 1 meter square in cross section, and will impose a load upon it of 300 tons. Experience has abundantly proved that testing iron conduces to improvements in its manufacture. No doubt some people think tests an unnecessary expense, and others have thought that proving a chain makes it permanently weaker, like overstraining the muscles of a strong man; and if the testing be not conducted rationally there is truth in these arguments. But if, when you come to insure your ships or your boilers you save more on the premium than you have spent in satisfying the tests, you have a proof that the testing has been good economy. So much has this proved to be the case that all the most successful shipbuilders buy and pay for tested material to put into their ships, whether those ships are to be classed at Lloyd's or not. It does not pay them to put work upon material which may afterward have to be rejected and replaced; with boilermakers, gunmakers, and other mechanical engineers it is the same. It is true that the government step in with their Chain Cables and Anchors Act for the protection of life at sea, and make the testing of chain cables and anchors compulsory, which shows that enlightened economy is not alone sufficient to restrain unprincipled competition, but all chain-cable makers are glad of the Act on economic grounds, whether they be of a philanthropic turn of mind or not.

The leading railway companies also, for their goods department, without compulsion by any Act of Parliament, are now making a practice of proving all the sling chains and crane chains on their systems in the most methodical manner, and are finding that the saving in casualties more than pays the whole expense of the testing department.

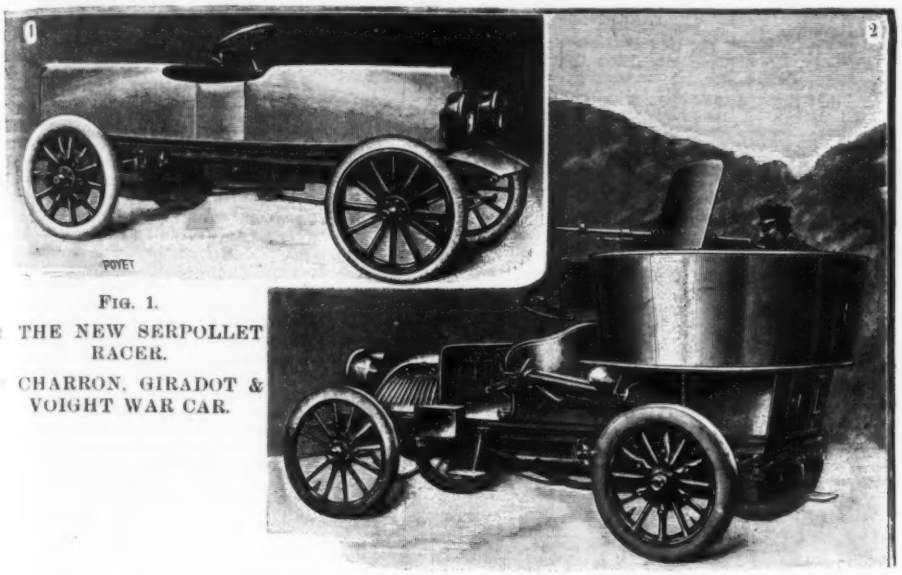


FIG. 1.

1. THE NEW SERPOLLET RACER.

2. CHARRON, GIRADOT & VOIGHT WAR CAR.

By testing the iron the mechanical engineer knows that his raw material, whether cast, malleable, or iron made into steel, has certain strengths and elasticities which he can count upon, and this knowledge prevents labor being wasted upon a quality of material unsuitable for the particular purpose he has in view.

NOVELTIES AT THE FIFTH ANNUAL PARIS AUTOMOBILE SHOW.

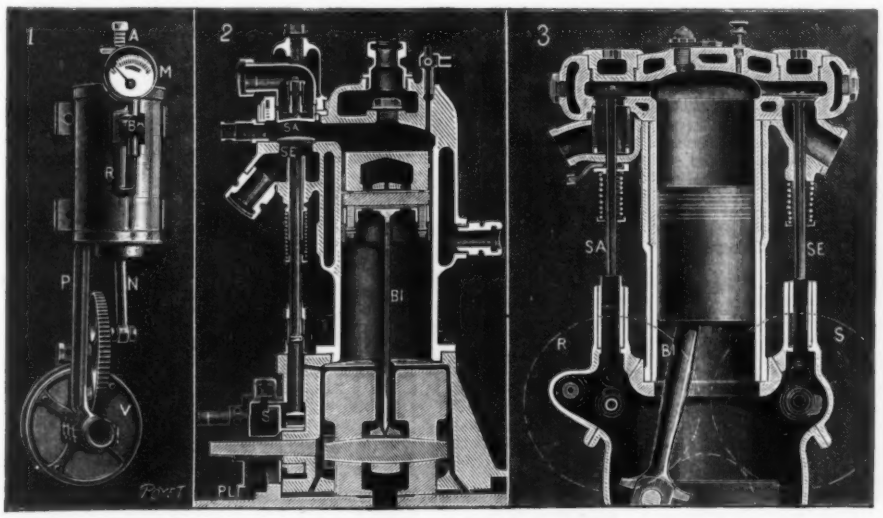
THE fifth annual French Automobile show, held in Paris last December, was a great success, and was attended, during the six days it lasted, by 220,000 visitors.

This result proves conclusively that the idea of the mechanical vehicle is gaining ground rapidly from year to year, in all classes of society. This, moreover, is justified by the rapid progress of this industry which, according to general opinion, has never before asserted itself so strongly as now.

Along general lines, the endeavors of constructors the past year have been toward simplicity and the reduction of noise. Simplicity allows the automobile to be used by a greater number of inexperienced persons and increases, therefore, the number of users that the complexity of the mechanisms heretofore evidently restrained. As for the attenuation of the noise, at the same time that it removes from the automobile one of its bad features, it increases sensibly the power at the wheels of the vehicle, since shock and vibration are manifest losses of this to such an extent that a more powerful motor is necessary to propel a vehicle of a given weight at a given speed, if it makes noise, than to drive an identical car at the same speed, if it moves without trepidation, without vibration, and silently.

Simplicity is gained, in the first place, in the method of oiling the motor. Heretofore, with the Dion-Bouton motor for example, the operator was obliged to pour or pump into the crankcase a measure of oil every 25 miles or so. The crank, splashing in the oil, churned it into a veritable emulsion, which was splashed over the bearings and upon the piston. Now, the same motor will run without attention for 300 miles. A small two-pint reservoir attached to the cylinder feeds all the bearings by gravity. The oil collects in the crankcase, and is raised again to the reservoir by a small pump driven by a worm gear from the motor shaft. In this manner the working parts of the motor constantly receive a perfect stream of oil, which conduces to the most thorough lubrication.

Mechanically operated inlet valves were one of the new features on many cars. As is well known, heretofore, on gasoline automobile motors the inlet valve has generally been opened automatically by the suction of the piston, while the exhaust valve is always operated mechanically by a cam on the two-to-one shaft of the motor. In illustration No. 2, Fig. 3, for example, *SA* is a light valve, held on its seat by a coiled spring. When the piston, drawn downward by its connecting-rod *BI*, descends, it tends to produce a vacuum, which causes valve *SA* to open, and allows a charge of gas to be drawn into the cylinder. In like manner, at another part of the cycle, the large gear *S* of the two-to-one shaft, which is driven by the pinion *PL* on the motor shaft, will raise, by means of a cam on its shaft, the exhaust valve *SE*, through which the burnt gases escape. But the automatic inlet valve has several disadvantages, viz., difficulty of regulating the tension of the spring, failure to work at high speeds, etc. A number of manufacturers have therefore decided to operate this valve mechanically. In Fig. 3, No. 3, consequently, *SA* is seen arranged identically with *SE*; and the pinion on the motor shaft drives two two-to-one cam shafts, one for opening the exhaust valve and the other for opening the inlet valve.



1. The auto pump: A, screw for raising or lowering through P the friction disk V; M, pressure gage; R, pump cylinder; N, connecting rod. 2. Cross section of motor with automatic inlet valve. 3. Cross section of motor with mechanically operated inlet valve.

FIG. 3.—VIEWS OF NEW MOTOR.

The disadvantage of the mechanically operated inlet valve is the complication that it causes. But its advantages are also numerous, viz., similarity of the valves and their springs, thus making them interchangeable; greater thickness of the inlet valve, which will therefore not warp from extreme heat; indifference of the valve to wide variations in the spring. The power of the motor does not always seem to be increased by this arrangement, however, despite this claim that is made for it. It has even been claimed, but wrongly, that the mechanically-operated inlet valve permits the motor to be run at a much slower speed than the automatic valve will allow. In reality, the great flexibility possessed by the automobile gasoline motor of to-day, by which a speed variation of from 150 to 1,200 R. P. M. is obtained, is due to the improvements made in carburation. The best apparatus that has as yet been devised with a view to automatically solving the difficult problem of good carburation at all speeds, is that invented by Commandant Krebs. (For description, see SCIENTIFIC AMERICAN for February 14, 1903.)

By running the motor at slow speeds and using fiber or rawhide gears, edged with bronze, the gasoline automobiles have been made to run very silently. They do not yet rival on this point the steam carriages which sometimes brush by foot passengers without their perceiving it, but they have nevertheless made an appreciable advance that all nervous people will appreciate.

The comfort of drivers of gasoline touring cars has been greatly increased by the invention of a motor-

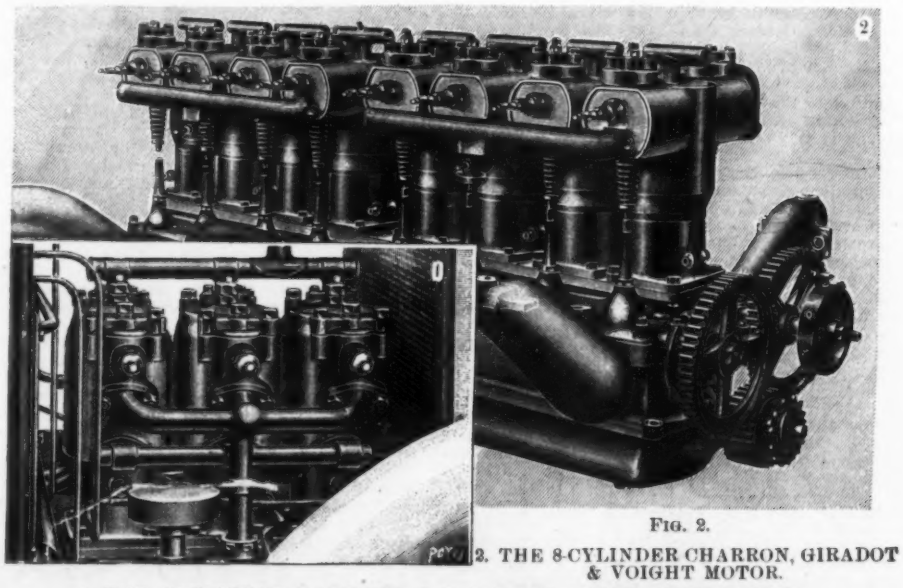


FIG. 2.

1. THE 3-CYLINDER PANHARD & LEVASSOR "CENTAURE" MOTOR.

2. THE 8-CYLINDER CHARRON, GIRADOT & VOIGHT MOTOR.

driven pump for blowing up tires. This apparatus, seen in Fig. 3, No. 1, is driven from the motor flywheel by a friction, leather-faced pulley *V*, which drives by a worm gear a large gear wheel. This in turn moves the piston of the pump through the connecting-rod, *N*.

Among the most frequented curiosities of the show should be mentioned the new Panhard three-cylinder motor (Fig. 2, No. 1), which has its cranks set at 120 deg. and is, consequently, nearly as well balanced as a four-cylinder motor; and the Charron, Girardot & Voight eight-cylinder motor (Fig. 2, No. 2), which has an explosion every quarter of a revolution, thus assuring its running with great regularity. This firm showed, besides its regular models, a war car with a Hotchkiss gun mounted in the rear for the purpose of protecting officers on reconnaissance duty from the enemy's cavalry—a combination of which the recent Boer war has shown the need.

The Serpollet firm, which for two years now has valiantly waged the war of steam against gasoline, and which was the first to bring the speed record up to 125 kilometers (77.62 miles) per hour, showed a new racer which is to test its capabilities in the speed trials this year (Fig. 1, No. 1). This machine is capable of developing 100 horse power for a few minutes, and probably of attaining a speed of 150 kilometers (93.15 miles) an hour. It is hard to believe, therefore, but that the explosive motor is to be irretrievably vanquished on short distances such as the mile and kilometer. The renewal of the conflict will take place in March at the Nice fêtes.—Translated from the French of L. Baudry de Saunier, in La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

UTILIZATION OF THE PRESSED RESIDUES OF OLIVES.*

THIS utilization can be secured by dry distillation for the manufacture of charcoal, methylic alcohol, calcium acetate, acetic acid, acetone, wood tar, and other products.

We have been long engaged in the dry distillation of wood, an industry well developed in Central Europe, but which has remained almost unknown in the South, on account of the absence of forests.

This penury in wood has caused us to study first materials capable of replacing wood, in order to organize methods for the manufacture of chemical products, which are now imported in large quantities from the United States of America into Spain, France, and Italy, to serve for the production of acetic acid, acetone, and other products. Investigation of the residues of different industries has led us to believe that the material offering the best chances of success are the exhausted residues of olives.

We have been unceasingly occupied since 1897 with investigations to ascertain the best conditions for the manipulation of these residues by dry distillation, residues which have been treated by washing or with carbon sulphide. They are produced in large quantities in Spain, Algeria, Tunis, Greece, Asia Minor, Crete, and Italy.

Until now, these pressed olives have been partly employed, for want of a better opportunity, as a combustible of slight value and partly as a fertilizer.

In Spain the cultivation of the olive is carried on in thirty-three provinces. Among these, in the south, are the provinces of Jaen, Cordova, Sevilla, Malaga, Cadiz, in which there are 68,000 hectares devoted to this cultivation, as well as large tracts in the other provinces. On the average, a harvest of about 20 liters of olives per tree, and about 18 hectoliters per hectare, may be expected, figures representing, for the provinces named, an annual production of 12,240,000 hectoliters of olives, furnishing about 15 to 25 p. c., or at least 1,836,000 hectoliters of olive oil, and from 30 to 40 p. c., or 4,900,000 hectoliters (350,000 tons), of the pressed residues of the oil and stones.

On the average, the annual harvest of olives of all the Spanish provinces rises to 2,936,384 hectoliters, and the quantity of the residues to 550,000 tons.

Italy devotes 1,043,579 hectares to the cultivation of olives. In 1900, the amount of the olive oil produced was 1,500,000 hectoliters, with 300,000 tons of residues, thus distributed: 75,000 tons in Sicily, 100,000 in the south of Italy (provinces on the Adriatic Sea), 75,000 in the south of Italy (provinces of the Mediterranean), and 50,000 in the center and north of Italy.

France, Algeria, and Tunis.—While the production of olives in France is limited to a few southern provinces, in Algeria and Tunis it is as important as in Spain.

Greece, including the islands of Crete and Samos, and Asia Minor, also cultivate olives extensively, and these countries dispose of a considerable quantity of residues.

Supposing that half the residues of the olives are obtainable for dry distillation, we have the following figures: Spain, about 200,000 tons; Italy, 150,000 tons; Algeria and Tunis, about 150,000 tons; other Mediterranean countries, about 100,000 tons; total, 800,000 tons per year.

As is known, the olives, after the extraction of the oil, are washed with water, or submitted to extraction with carbon sulphide in order to obtain the 10 or 12 per cent of oil still remaining; afterward they serve as cheap combustible, or as a fertilizing substance, on account of their percentage in nitrogen.

On the average, the price per ton of the exhausted residues dry is 5 francs in large quantities, but oil-works installed on a modern basis cover by means of the sale of the extracted oil, not only the expenses for exhausting the residues and the other expenses of manufacture, but, as we have been able to ascertain in Spain, the profits are such that the residues cost nothing.

In Spain, Algeria, and Tunis, there are yet few extracting works, but in the south of Italy, especially in the environs of Bari this industry is well developed, and the residues are partly employed as a combustible in the factories at low prices. A small part is carbonized in a primitive way, and the coal resulting serves for the heating of boilers.

Dry distillation of olive residues (carbonization with recuperation of accessory products), requires apparatus of special construction. For several years we have been experimenting, in order to obviate the difficulties presented by the peculiarities of the matter. We have succeeded in constructing apparatus of large capacity, capable of distilling 10,000 kilogrammes of residues per day, which we have patented in all the Mediterranean countries. In Spain, we have secured the exclusive right of utilizing the pressed olives by means of dry distillation.

The yield in chemical products resulting from this distillation may be compared to that of the dry distillation of the best beech and oak wood, and we do not exaggerate in saying that the residues can, in the southern countries, completely replace the beech forests of central Europe for the manufacture of acetic acid, methylic alcohol, acetone, and charcoal.

The charcoal furnished by the distillation of the residues contains but little ash and its calorific power is about 6,800 calories. The form of briquettes or Paris charcoal can be readily given to it. These possess great resistance to fire, according to the experiments made on the subject, and good prices are obtained for the briquettes.

Where wood charcoal is lacking, or held at a high price, as for example in Tunis and Algeria, the briquettes may give rise to a profitable industry, allowing of the establishment of blast furnaces for treating and utilizing the rich iron ores found there.

* From the French of Drs. Jurgensen and Bauschlicher in La Revue des Produits Chimiques.

CAPTAIN SVERDRUP'S EXPLORATIONS IN GREENLAND.

CAPT. OTTO SVERDRUP recently delivered a lecture before the Royal Geographical Society of Great Britain, dealing with his recent discoveries and explorations in northwest Greenland. The cost of this expedition was defrayed by Messrs. Axel Heiberg and Ringnes Brothers, and Dr. Nansen's vessel "Fram" was renovated by the Norwegian government, for Capt. Sverdrup for the exploration. The object of the expedition was to spend the winter in the Arctic regions, and carry out the scientific exploration of the northwest coast of Greenland by means of sledging operations. The party comprised, in addition to Capt. Sverdrup, Capt. Baumann, second in command, magnetician; Capt. Isachsen, cartographer; Mr. Simmery, botanist; Mr. Day, zoologist; Dr. Svendsen, medical officer; and Mr. Per Schei, geologist. The "Fram" left Christiania on June 24, 1898, for the west coast of Greenland, where 66 dogs were shipped. On August 7 the vessel was set fast in the ice in Melville Bay, and eventually wintered in a sheltered cove in the northern part of Rice Strait. Two expeditions were made across Ellesmere Land to its west coast in the spring of 1899, one under Captain Sverdrup, which set out in one direction; and the other commanded by Captain Isachsen with a companion, which traveled over the glaciated part, though the latter journey was not attended by any important results. In the spring of 1900 a depot was established some 60 miles to the west and named Björneberg, in the southwest of Ellesmere Land. Further sledge operations resulted in the discovery of Big Bear Cape, Cape Sydvest, and Norwegian Bay. Intense cold prevailed, but fortunately it did not exercise any ill effects upon the party, a circumstance due to the precautionary utilization of double tents. When the men had become somewhat more acclimated to the prevailing conditions they were able to avoid almost entirely the moisture which always adheres to the clothing in high altitudes, and which has so often caused so much discomfort to Arctic travelers.

The expedition discovered new land extending to the west beyond Cape Sydvest. This proved to be two islands, and they were named Ellef Ringnes Land, and Amund Ringnes Land, respectively, in honor of the two brothers who had assisted in the financing of the expedition. The further explorations of Captains Sverdrup and Schei proved that Axel Heiberg Land stretched as far northward as they could discern. From the most northerly point which they succeeded in gaining they found that Greely Fjord penetrated Grinnell Land toward the northeast, and was confronted on the west by a high mountain chain, the sides of which dropped almost perpendicularly into the water of the fjord. On the whole Axel Heiberg Land so far as they could ascertain, was comparatively of a low level, the land in no case rising higher than 1,500 feet or 2,000 feet above sea level. Between these high levels and the sea was a belt of lowlands.

The sledging parties encountered several dangers in addition to those actually indigenous to the traveling, which in itself was extremely hazardous. One night the dogs were attacked by a pack of ferocious wolves. The dogs had been muzzled for the night so as to prevent their biting through their traces and thus escaping, and this fact prevented them defending themselves. Had it not been for the timely arrival of some members of the party the dogs would all have been worried to death. On another occasion the party was overtaken by a terrific snowstorm, such as is only experienced in the Arctic circle. The wind was so violent that it blew the sledges over the ice at such a pace that they were almost overturned, while the snow fell so thickly and fast that the members of the party couldn't see more than a few inches before them, so that they had practically to trust to Providence for safety.

The sledging explorations proved that the Ringnes Islands extended westward to approximately 106 deg. west and as far north as 79 deg. latitude. The land in this instance was for the most part very low, the highest altitudes not exceeding 500 feet above sea level. The coasts shelved gradually into the water. The most northerly point reached on Axel Heiberg Land was Land's Nok 81 deg. 40 min. latitude by 94 deg. west. From the results of these discoveries it is surmised that the Ringnes Islands form the natural termination of the polar archipelago that lies north of the American continent, and is of opinion that no further land exists in this direction, since so far as he could see there was nothing visible but water covered with coarse Arctic ice. Captain Sverdrup discovered no traces of glaciers on either the islands or Axel Heiberg Land, though on King Oscar Land there was abundance of glacier ice. The precipitation was very small and in no instance was sufficient material furnished for inland ice.

Prolific evidences of animal life were visible upon portions of the newly discovered land, and large numbers of musk oxen and smaller game, such as hares and ptarmigans in addition to foxes and wolves were seen. Reindeer exist to the west, but only in very limited numbers. On the western side of Heiberg Land plenty of reindeer were found, but no traces of musk oxen. In some districts some polar bears abound, but no traces of these animals were found north of Cape Sydvest. The remains of Eskimo habitations were found almost everywhere, the discoveries in this connection comprising winter huts built of stone and whalebone, tents, meat stores and fox traps. These indications of humanity only existed upon the eastern side of Axel Heiberg Land, and along the coast between Greely Fjord and Land's Nok, while on the west side of the former land not even the slightest traces of Eskimos were to be found. Two curious stone towers were discovered at Björneborg which Capt. Sverdrup associated with Eskimo occupation, but upon this point there was no conclusive evidence. Capt. Sverdrup thinks it possible that the route followed by the Eskimos in their migrations to Greenland follows a northeasterly route across the North American archipelago, northward along the coast of King Oscar Land, through Eureka Sound into Greely Fjord, thence overland to Archer Fjord and then onward in a northerly direction to North Greenland. The expedition reached Goosefield on July 2, 1902, and left that point on August 6, their departure being delayed through the bad condition of the ice. On August 17 they reached Godhavn, and finally Norway on September 19 of the same year, having been absent for more than four years. The expedition secured a valuable collection of meteorological reports, observations for which were taken every two hours both in summer and winter. Records were also secured of the temperatures of the sea, ice, and tidal water. At the several winter quarters of the expedition magnetic observations were also made. The scientific staff also accomplished some valuable work, and secured rich and valuable materials pertaining to the zoology, botany, and geology, of these new lands in the Arctic zone which had never previously been visited.

DISCOVERY OF REMAINS OF BERMONDSEY ABBEY.

IN the course of recent excavations for the erection of working-class dwellings by the South-Eastern Railway Co., upon land belonging to the London County Council, there have been dug up what are considered to be fragments of the foundations and lower courses of the chancel of the abbey church. According to the Builder further excavation has brought to light pieces of apparently a large perpendicular window and doorway, also of a hood-moulding and an arch of the Early English type, and similar fragments. Timbs, in his "Curiosities of London," cites a drawing in the Upcott Collection showing the monastery as rebuilt early in the reign of Edward III., and the cloisters and refectory in 1380. Katharine of Valois found sanctuary there after the death of her husband, Henry V., and there also died Elizabeth Woodville, widow of Edward IV. For the site itself we may direct attention to a ground-plot plan that was engraved and published by Robert Wilkinson on January 1, 1822, and is described as being from an original drawing taken in 1679—that is to say, nearly 140 years after Sir Thomas Pope had pulled down the church, together with most of the conventual buildings. On that plan "the ground-plot of the old abbey church" is hatched-in upon the sites of some buildings along the north side of Long-walk, on the north side of "the Base Court-yard" (afterward Bermondsey-square), and parallel with the later Abbey street. One of those buildings, which is detached, is lettered as "The Rev. W. Whitaker's Meeting House (he was an Ejected Minister, 1662)." The meeting house is plotted in the southeastern portion of the nave of the church which measures, to the scale, 170 feet in length, the chancel included, by 60 feet in width at the west end. At the west end of Grange walk is the site of the East Gatehouse opening into the Base Court yard, and to the south of it are "the Coney-grew" and "the Stable yard." Between Long-walk and the East Gatehouse stands "the Bakehouse," between which and Long-walk are plotted "where the Mansion House stood," and "the ery of the Mansion House," as on the east side of the later square. That was the house, known as Bermondsey House, which Sir Thomas Pope built for himself out of the materials of the church, and which, with its gardens, orchards, pasture lands, ponds, and so on, covered about twenty acres.

Of Pope's house there is an interesting water color drawing, made by T. H. Shepherd sixty years ago, in the Crace Collection, which shows the old stones in the walling. At the northwest angle of the square stood the North Gate, or Great Gatehouse, and just beyond it the West Gate, where is now Bermondsey New-road. In the Crace Collection is the original drawing of the former, by C. I. M. Whichello, of which Wilkinson published an engraving in September, 1820; on the northern side of the gatehouse he depicts the graveyard of St. Mary Magdalen Church. The gatehouse and some adjoining portions of the conventual buildings remained until 1806, when Abbey street and most of the square were laid out. The Abbey of the Holy Saviour was originally a priory of Benedictine monks brought in 1082 from Cluny, whom Aylwin Child endowed with some rents in the City of London. At the instance of Richard II., Pope Boniface in 1399 erected the priory into an abbey, which at one time was among the richest and most important in the kingdom. On July 8, 1541, the

abbey site was granted to Sir Robert Southwell, Master of the Rolls, who on August 30, of that same year conveyed it in fee to Sir Thomas Pope, Treasurer of the Court of Augmentations, and his wife. Pope, it is true, pulled down the church, but he saved St. Albans from destruction, and he devoted part of his gains to the building and endowment of Trinity College, Oxford. The late Dr. Rendle, of Southwark, says that Pope caused the Rood of Grace to be removed from the church to the common in Horselydown at the end of the present Crucifix-lane. It was destroyed by the populace, together with the Rood of Grace, from Boxley in Kent, after a sermon preached at Paul's Cross by the Bishop of Rochester on St. Matthew's Day, February 25, of that year.

NEW FORM OF RADIATION; EXPERIMENTS OF M. BLONDLOT.

IN a paper recently presented to the Academie des Sciences, M. R. Blondlot describes a series of experiments in which he appears to have discovered a new form of radiation. The rays in question are produced by the cathode tube, but unlike the X-rays may be reflected and also refracted by a prism, concentrated to a focus by a lens, etc., and they are therefore analogous to light rays. The experiments were carried out as follows: The radiation emitted by a cathode tube provided with a reflecting terminal are filtered through a sheet of aluminium or a screen of black paper to cut off the light rays which accompany it. The radiation which passed through the screen was studied by means of its action upon a small spark. The spark is produced between a pair of points which are placed in deviation upon the principal circuit. The radiation shows from the outset a rectilinear polarization. When the rays traverse a plate of quartz perpendicular to its axis or a piece of sugar their plane undergoes a rotation similar to the rotation of the plane of polarization which occurs in the case of light rays. In passing the rays through a pile of mica sheets constituting a Reutsch cell a rotation of 25 or 30 deg. is obtained in the same direction as for polarized light. This action of the mica led the author to suppose that a single plate of mica should produce an effect, and that this effect should be the depolarization or rather the production of an elliptical polarization. This in fact proved to be the case. The interposition of a plate of mica, directed so that its axis made an angle of 45 deg. with the plane of action of the radiation from the tube, destroyed the rectilinear polarization, as in this case the action on the small spark remained about the same in different positions of the latter. If a second plate of mica like the first is interposed so that the axes of the two plates are perpendicular to each other the rectilinear polarization is re-established. It is therefore certain that an elliptical polarization is produced. But if the mica plate changes the rectilinear polarization to elliptical, this plate must be bi-refracting for the radiations that it thus changes. If double refraction exists it follows *a fortiori* that simple refraction exists also and the author was led to examine whether in spite of all negative results in searching for the refraction of X-rays he would not obtain a deflection of the rays by a prism.

He then made the following experiment: The cathode tube sends through an aluminium screen a beam of rays which is limited by the crossed slits of two parallel lead plates three millimeters thick. The small spark is placed at the side of the beam and at such a distance that it is not acted upon. This is proved by interposing a lead plate, when the brightness of the spark is not diminished. An equilateral prism of quartz is now interposed in the path of the beam, with the refracting angle placed on the side opposite the spark. If the prism is properly placed the spark becomes more brilliant. When the prism is removed the spark weakens again. This phenomenon is certainly due to the refraction of the beam, for if the prism is turned through an angle or replaced by a quartz plate no effect is observed. The experiment can be made in another way. The beam is let fall upon the spark and then deflected by the prism. The beam is then searched for by shifting the spark, and it is found that it has been deflected toward the base of the prism as in the case of light. After demonstrating the refraction the author tried to concentrate the rays by means of a quartz lens and succeeded very well in doing so. He thus obtained the "image" (invisible of course) of the anti-cathode pole, which was very well defined as to size and distance by the increase in brightness of the exploring spark. The existence of refraction made it probable that a regular reflection also exists and this was proved. By the aid of a quartz lens or a lens formed of a thin horn envelope filled with turpentine he produced a conjugate focus of the anti-cathode and then intercepted the beam by a polished glass plate placed obliquely; he then obtained a focus which was symmetrical with relation to the plane of reflection to that which existed in the first place. With ground glass the reflection was no longer regular, but a diffusion takes place. If one half of a mica sheet is ground and the other half left clear, the latter will allow the rays to pass while the former intercepts them.

In all these experiments it results that the rays studied by M. Blondlot are not the same as X-rays, since the latter are not refracted or reflected, and the action of the small spark reveals a new kind of radiation emitted by the cathode tube. These rays traverse aluminium, black paper, wood, etc. They have a rectilinear polarization and are capable of taking a rotary or elliptical polarization; they can also be reflected, refracted, and diffused, but do not appear to produce fluorescence or photographic action. The author supposes that certain of the rays have an index of refraction = 2, but it is probable that there exists a whole spectrum, for in the experiments of refraction by a prism, the deflected beam seemed to occupy a great angular extent. The study of the dispersion of the beam is next to be made and also the wave-lengths.

Liquid Stove Polish.—Graphite (often misnamed black-lead) is the foundation ingredient in a stove polish. Lampblack is frequently added to deepen the color, but the latter form of carbon is of course more readily burned off than the former.

The powder variety of stove polish is merely purified and ground graphite with or without the addition of lampblack. It is applied to the stove by being first mixed with a little water.

The following formula gives a "liquid" stove blacking:

Graphite in fine powder	1 pound
Lampblack	1 ounce
Rosin	4 ounces
Turpentine	1 gallon

This form may be esteemed a convenience by some, but the rosin will, of course, give rise to some disagreeable odor on first heating the stove, after the liquid is applied.

The mixture must be well shaken while in use, and must not be applied when there is a fire or light near on account of the inflammability of the vapor.

The coating produced must be well rubbed with a brush to obtain a handsome finish.—Drug. Circ.

THE LAST OF THE LAPPS.

THE Lapps are decreasing in number. The most sanguine estimate of the numbers of the entire race in Norway, Sweden, and Russia does not place them above 54,000. By some the number is placed far lower on the strength of trustworthy data. In Norbotten the number of Lapps in 1897 was 3,375, of whom 2,500 were nomad Lapps and 875 were settled Lapps, since a certain number of Lapp families, abandoning their wandering habits, have built fixed habitations here and there, and endeavored, with more or less success, to imitate the life of the Swedish settler. That the race must eventually die out is certain, and its diminution may be very speedy, though its complete extinction is perhaps still far off, since there is no other race that can possibly take its place on the high reindeer fjäll. Yet even here we come upon a factor which has, perhaps, hardly been reckoned with. We mean the decrease of the herds of tame reindeer. This has been going on in the last quarter of a century with striking rapidity. In one district alone in the last twelve years the reindeer have diminished from an estimated 30,000 to an estimated 7,000. This decrease is explained variously. The commonest and most plausible explanation, which carries the authority of men well qualified to judge, is that the demand for reindeer flesh, which has been brought nearer to the Lapps by the opening of the Bothnian Railway, has tempted them to part with their deer at a rate too rapid for their production. The herds of reindeer, when they are taken off the high fjäll down to their winter quarters, are now within four or five days of Stockholm, and there is a good demand for reindeer flesh. It is said that the Lapp, who is no more able to resist strong drink than any other half-civilized man, is plied freely with brandy, and in that state will part with his reindeer for a trifling sum, or even for a fresh bottle of spirits or two. And he goes back to his fjäll stripped of half his herd, and with nothing to show for it. But there is another cause also alleged, and that by equally good authority. It is said that Swedish State education is having upon the Lapps the effect which not uncommonly follows the early stages of learning. Every autumn Swedes and Laps alike send down their children to the nearest national school, where they remain for the winter months, the Lapps in most cases having "seminaries" to themselves. And it is declared that, in the case of both races alike, after a few years of this training the young generation, when it comes to the age of choosing its way of life, shows an unwillingness to return to the hard outdoor life of the homes in the interior.

THE UTILIZATION OF PEANUTS MEDICINALLY.*

By W. H. FRIERSON.

WRAPPED in its somewhat uncouth casement, there is in the common ground-pea a storehouse of medicinal and food products. Chemistry is unfolding its values.

When the Czar of all the Russias, a few years ago, had his armies fed on a preparation made from the pinder or groundpea, at once wholesome and palatable, with economy as an additional point of merit, the entering wedge was driven which has since been opening an increasing public appreciation of the hidden values of this humble farm product. Germany saw it, and to-day the Kaiser's army is served regularly with bread and a porridge made largely from the peanut. German chemists, under the direction of the government, have been for some time endeavoring to extract the active principle of the groundpea for service in concentrated, palatable, liquid form.

Some time during 1901, Dr. D. H. Ramsaur, then of Rome, Ga., conceived the idea of an elixir of peanuts as a soda fountain beverage, but all his experiments proved to be failures, for the reason that, while he did succeed in making the elixir, it would not mix with water so as to form a pleasant drink. In January, 1903, W. B. Nethery, Ph.G., formerly of Canada, became associated with Dr. Ramsaur, and opened a laboratory in Anderson, S. C., and continued to pursue these experiments with the same end in view.

In what he calls "penderine," he has an elixir which contains a large percentage of the medicinal and food properties of the pinder, and is compatible in all proportions with carbonated water or plain water, and at all temperatures. One part of the elixir to seven of water affords a most delicious draft.

The pinder contains oil, starch, gluten, and many other chemical compounds. None of these is readily assimilated by the system until they have been digested. To aid in this process, the pinders are first cooked, then digested by a chemical process similar to, but slower and more thorough than, that which goes on in the stomach of the human or other animal.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

The next step is to segregate the digestible from the non-digestible portions. The digestive agents employed are peptinzyme, pancreatin, diastase, hydrochloric acid and others. The excess of hydrochloric acid is removed by the use of sodium carbonate, which tends to saponify the indigestible fats and forms with the hydrochloric acid common salt, which goes to the bottom, while the soapy substance, which is insoluble, rises to the top and is easily skimmed, or may be removed by means of a centrifugal machine.

Now we have the goober juice ready for incorporation into the elixir. This juice of itself is very sweet, like a syrup, and in order to be rendered palatable, requires only to be combined with tasty, palatable aromatics. But in this the greatest care must be observed; for while there are many tasty flavors, there are few that are entirely reliable. In these days of synthetic chemistry, one scarcely knows whether his pineapple extract came from the juice of the fruit whose name it bears, or was made by a synthesis of its elements in the laboratory of some chemist. Only the purest extracts may be safely used, and one of the most important employed in the manufacture of penderine is derived from the pinder itself.

Aside from the juice obtained by the digestive process above described, there is also obtained (in this latter case from the roasted pinder) an extract of high medicinal value. Together with these extracts from the pinder, and the flavors mentioned, is incorporated animal nuclein. This latter agent is a most important addition to the compound, as it assists in digestion, and is an active builder of tissue, the great work of maintaining life. The principal office of proto nuclein is to act on the white blood corpuscles, the number of which it tends to increase. The strength of the system, and its power to resist contagious diseases, depends largely on the percentage of white corpuscles present in the vital fluid.

Ranging from delicate perfumes potent as the fragrance of the rose to inert matter that goes to the swill barrel, there are a number of by-products that may be made to go far toward cheapening the cost of production of the principal thing, the penderine elixir. Two of these are worthy of mention. By the addition of a small quantity of other substances is obtained a most wholesome, digestible prepared food, suited to weak constitutions, very similar in taste and quality to grape-nuts. In the process, the objectionable brown husk, which remains during the original cooking process, is removed. The other by-product is a dried substance resembling ground coffee, and which, when properly manipulated and mixed with bone or shell and medicated, becomes a poultry food of decided value.

DECALCOMANIA.

THE transferring of prints known as decalcomania is the process of permanently transferring pictures or designs from paper on to leather, wood, stone, glass, china, iron, etc., invented in 1852, but perfected only within the last few years. The transfer pictures are printed by the lithographic process usually employed for colored prints, except for a few details. From the original colored painting or sketch the artist makes as many engravings or so-called original plates as there are colors in the sketch to be reproduced, and besides these, one plate called the keyplate, which itself is not printed, but serves simply as a guiding outline for the others. This keyplate is impressed upon lithograph stones, say eight of them, if there are eight colors in the sketch, and the various colored plates are then transferred to a stone comprising as many duplicate plates as are desired to be printed at once. Great care is needed to secure exact alignment of these various plates with the outline and are required to register perfectly with each succeeding color. Each color is etched into its stone in oil, so that it may be printed as usual in lithography. The sketch is printed face down on the paper, in order that when transferred it may appear right side up. This printing face down is the first departure from the ordinary procedure in lithography; but it greatly increases the difficulty of printing, for each color that is added makes the face of the picture less visible to the operator, so that great experience is required to produce the needed finished result. Another departure is the use of gummed paper to receive the impressions. It is so sensitive that atmospheric changes of a few degrees in temperature and humidity expand it by five-tenths per cent, and so ruin the work by making perfect registry impossible. Care is therefore taken to maintain the air of the printing-room at a standard condition throughout the year. This paper, moreover, must be quite compact and at the same time sufficiently porous to absorb water rapidly during the transfer process. The coating laid upon this paper to receive the colored impressions consists of several layers of various composition, and is afterward very highly polished. It must dissolve within a few seconds when touched by the water, which must percolate through the paper of the design.

The transferring of the design is simple enough, and can be done by youths of either sex. A special preparation of varnish is spread over the print and allowed to lie until it becomes sticky or "tacky." The print is then placed upon the article to be decorated, the back then saturated with water, and pressed down. After a few seconds' contact, this paper back is carefully removed, and the print found transferred to the article.

The commercial uses of such transfer pictures are well nigh endless. Their original use, about 1852, was as playthings for children, and many millions have been sold throughout the world for this purpose to barbarian and civilized alike. The inventor was German, and the first commercial developments were confined to German lithographers. They first used transfer pictures to decorate with imitation gold leaf the ugly black iron heads of sewing machines. This practice has improved, until to-day, beautiful effects in mother-of-pearl marquetry and floral designs are in common use, not only for such machines, but for bicycles, typewriters, carriages, agricultural machinery, and other wood or metal articles of every description, all of which are now decorated almost exclusively by decalcomania. Trade-marking and branding on

wooden and metal articles are now effected in the same way.

But the most far-reaching of all these applications was one adopted only recently, the decoration of chinaware in mineral pigments. Attempts made by lithographers for many years proved abortive from lack of technical knowledge in china decoration, but when decorators familiar with mineral colors in their relation to firing attacked the problem, success quickly followed, and decalcomania immediately sprang into vogue with the leading china factors in Limoges, Dresden, and Staffordshire, in Europe, and such well-known American pottery cities as East Liverpool, Ohio, Trenton, New Jersey, and Wheeling, West Virginia.

For chinaware the ingredients of the varnish must differ from that ordinarily used, and great care is needed in the firing to obtain sharp outlines, clear body, brilliant colors, and a sinking under the glaze which will permanently protect the design.

Decalcomania effects great saving in labor. The prints and their application to a dinner set of a hundred pieces cost only about one dollar, whereas the same decoration applied by hand would cost fifty times that amount. The last application of decalcomania is to signs and window lettering or designs used principally for advertising purposes, which can be supplied in quantity for as many cents as the hand-painted article would cost dollars. The commercial uses of this application for advertising are obvious, and are likely to be used in ever increasing quantities. —The World To-Day.

RESTORATIONS AND "FAKES."

"RESTORATION" is the elegant euphemism generally adopted in the world of collectors to designate work of which the most manifest result is often to make of a shapeless fragment an intact object of art, such as it originally appeared, with the patina of age carefully imitated. Now, if we concede the principle of restoration, there is no telling to what point we may be led. Where will it stop? Where will begin what people ready with words bluntly call "faking"? Let us, for example, pass through the Gallery of Antiques at the Louvre. Here, contrary to what occurs with paintings and works of art, the work that has been performed upon masterpieces is acknowledged. Now, here are six statues selected almost at random from all the others. We might have given twenty, fifty, or a hundred just as authentic as regards origin, and all just as much restored. What do we find? None was entire at the time at which it was brought to light, whether exhumed from the soil of France or of Italy. Whether, like the "Venus of Arles," offered to King Sun himself as a gift worthy of him, or whether, like the "Borghese Love," acquired at the cost of gold in order to enrich some princely collection, all have been completed, repaired, and restored before becoming ornaments of our museums. The majority had great need of it. Do you know that the divine "Victory of Samothracia" was, when discovered, in a hundred and twenty pieces, without counting the prow in which it has been placed for but a few years? When we read the labels which a scrupulous administration has placed upon their pedestals, we ask ourselves with regard to some of them, the "Antinoüs as Hercules," for example, whether it would not have been shorter

THE BORGHESE LOVE.

Restorations: The end of the nose, almost the entire wing, the forearms and hands, the pieces that join the right leg, the right foot, a part of the left thigh with the leg and foot, several parts of the mantle, and the plinth.

to specify the little of them that was found intact rather than to enumerate the "principal restorations."

If, then, there is so much restoration work done in the State collections, in which the venal value of works of art counts for nothing in the eyes of those whose business is to preserve them, what had not collectors of art objects, spurred on by professional rivalry, or inflamed with the ambition of some day having their sensational sale, posthumous or not, ought to be capable of doing?

The two words "faking" and "restoring" become nearly synonymous; it is a question of more or less, and the official restorers have hardly any right to show themselves severe with antiquarians who go a little farther than they. They do not think, moreover, of claiming such right. M. Heron de Villefosse, in a recent interview, actually declared to a confrère that M. Spitzer (whose name was mixed up with the story

ANTINOÜS AS HERCULES.

The head is antique, but foreign to the body. Restorations: The greater part of the hair, a part of the left eyebrow, the nose and almost the whole of the upper lip, the chin, the neck, the arm and a portion of the right forearm, as well as the hand and fingers, the left forearm with the elbow and the wrist, the fingers of the left hand; the lion's skin, starting from the left elbow, the club and the rock; a portion of the right leg, the left leg, etc.

of the acquisition of the tiara of Saïtapharnes) had devoted himself to the collection of nothing but "authentic things." M. de Villefosse was either ridiculing the academic mode, and so perfectly, too, that his questioner was even unsuspicious of it, or else was affirming that transcendental skepticism which savants reach from having seen certain realities too closely.

This Spitzer collection, which has remained famous among all others in the history of international brokerage, is always the one to be first mentioned in conversation between the initiated, as soon as "faking" and "faked" objects are spoken of. In this line, it was the classic collection *par excellence*. Twenty good workmen labored for twenty years in forming it. It is of it that many of the best stories are told, and the suspicious rumors that arose at its dispersion, in 1893, have scarcely been dissipated. It would require another "great sale" of the same kind to make them forgotten. We shall have it some day.

The diverting story of the "Two Cousins," highly appreciated in the world of art, is typical enough in this regard to be recounted. One of the two cousins, then, who bore a name famous among great collectors, went one day to find Gauvain—a master workman, skillful chaser, and wonderful Damaskeener, who, after executing millions of chefs-d'œuvre, since catalogued as ancient, died almost in poverty—and ordered from him a Spanish sword of the beginning of the sixteenth century. As chance would have it, the other cousin, just at the same time, had been seized with a desire to have a gorget of the same epoch. Gauvain executed the two orders punctually, and delivered the objects to the cousins. A short time afterward, the first of these artistic amateurs, in a visit to the second, saw the gorget, and was gnawed with envy, for he believed that it was really ancient. He did not offer to purchase it, for there is a delicacy about such matters among people of the world of art; so he asked his cousin if he would exchange it for his sword. The owner of the gorget, who well knew what he was giving on his part, and had perfect confidence in the genuineness of the sword, agreed to the exchange, being very certain that he was getting a good bargain. The devil must have laughed, if the proverb does not lie.

At the first meeting of the Société des Collectionneurs, which included at this time such amateurs as MM. Odiot, Ressmann, ambassador of Italy, Darcel, conservator of the Cluny Museum, de Rothschild, Yriarte, Basilewsky, Sir Richard Wallace, and others, the man with the sword, in order to prove at a stroke his own cleverness and the inferiority of his poor cousin, hastened to whisper this little story into the ears of the members, while the other, on his side, with the same intention, peddled the same story about with a little diabolical laugh.

The case of an art object, manufactured in every part and copied from an ancient model, must, however, be quite rare. What is common is the beautifying or embellishment of an object that is vulgar, although genuine. A very simple cuirass or Swiss morion is taken and damaskeened. A pocket-pistol or an altar chandelier is restored; and the temptation of having a pair is not always resisted. It is easy to see that it is possible to go very far in this line. Cuvier, reconstructing an antediluvian animal upon the sight of a fossil bone, is a child alongside of some of the restoring collectors that are mentioned. From a bronze Louis XV. festoon they make a chest of drawers, and from a rusty cross-bar a Spanish long-sword of beautiful appearance, and even slightly dull. No mechanical feat seems to be beyond the range of their ability. Wood, metal, glass, enamel, faience have all been imitated by them by turns. By dint of ingenuity, their coadjutors have rediscovered long-forgotten and most secret processes. Those admirable ceramics of Oyron, of which but about forty pieces were known twenty years ago, have multiplied in abundance. In the Dutuit collection alone there are four or five pieces. Were these discovered? Some of them, doubtless, but many have been manufactured.

The inimitable "egg-shells," so fragile that one trembles to drink from them, are now copied in France in an admirable manner. In the Guimet Museum there is a small Chinese vase of the seventeenth century, or sold to M. Guimet as such, and which the collector was told, came from a Paris manufactory. The thing was so amusing that M. Guimet left the piece in the show case as a fine specimen of the perfection that has been reached in French industry.

It is asserted that, a few years ago, a multi-millionaire, Mr. Chas. Schwab, president of the steel trust, upon being advised by a friend not to buy an alleged Raphael for a million dollars, deliberately shrugged his shoulders and exclaimed: "Oh, pshaw! after it has become mine it will be genuine enough!" This theory, which is current morals with some of the amateurs, has greatly favored the trade in faked objects.

Neither the art of the restorer nor that of the forger dates from yesterday. As soon as the work began of digging into the soil of Greece and Italy, in order to extract therefrom the chefs-d'œuvre that were slumbering therein, the restorer too began his work. From the day on which, in his epoch, an artist achieved success, adroit counterfeiters began to imitate him. But it was reserved for our time to see an important trade gradually spring up from such clandestine traffic, and suddenly take its place in the broad light of day. It is now recognized and considered. There is scarcely any business that gives greater or more certain profit. It leads to fortune, and, by super-addition, to honor. It has even a philanthropic side, since a host of people live upon it.

Alfred Gauvain, who is mentioned above, had during his entire life, starting from the hour in which he proved his skill to collectors and found his vocation, no other occupation than that of making antiques. Up to the moment at which he had the imprudence to confide certain anecdotes to Philippe Burty, who began to publish them in the form of articles, he was for a long time the ordinary restorer of one of the wealthiest collectors of France. He was much amused, says his friend Baffier, upon seeing at the retrospective exposition at the Trocadero in 1878, the secretary of this Macænas, in the presence of two gentlemen of importance, Count Nieuwerkerke and M. Spitzer, doing honor to some ancient arms that had come from his hands a few months before. What marvels, now consecrated and catalogued, thus took their flight from his workshop on Rue Lebouis! The story of Jean Garnier, sculptor, enameler and chaser, is more affecting still. At the very beginning of his career he executed an admirable plate (signed with his name) in the style of the Renaissance and after a canto of the Divina Comedia. This, year after year, while suffering from poverty, he carried to amateurs and dealers, but no one wished it. Repulsed and desperate, the poor artist hid his plate in the most secret

THE GENIUS OF ETERNAL REST.

Restorations: To the upper part, of beautiful Greek style, is joined the lower part of a statue that is foreign to it—a fragment of the Roman epoch. Other restorations are: End of the nose and middle of the upper lip, top and bottom of the abdomen and parts of the thighs, connecting with the lower part of the body and the tree.

recess of his workshop, in order that he might no longer see it.

Nevertheless, others reaped from this piece an abundant harvest. During the course of its peregrinations, the plate had been molded by some manufacturer, and devoid of the signature of its true author, was currently sold almost everywhere, in plaster and in the form of electrotypes, as a work of the Italian Renaissance!

Garnier then made pasticcios, without ever putting his name to them. He also made admirable enamels, statuettes, medals, and jewels worthy of Benvenuto Cellini. Dealers and collectors quickly recognized his merit and gave a conspicuous place to his exquisite artistic creations, purchased by them for a piece of bread. In a French national collection, in one or two private ones, and in the South Kensington Museum, there are some Cellinis which are due simply to Jean Garnier. This did not prevent him from dying poorer still than Gauvain, at the very moment at which the Luxembourg had just purchased from him, too late, alas! the beautiful plate that was the prime cause of his misfortune.

It is thus that in every craft, unless quasi-miraculous circumstances intervene, the best artisans proceed to faking in order that they may not die of hunger.

In like manner, how many painters, now successful, had, at the outset, to be the collaborators of not overscrupulous picture dealers. It is asserted that Ribot had paternal eyes for certain Tassaerts, which he, the vigorous and somber painter, recognized, as he jokingly said, from the fact of their being lighter than the true ones.

And what has become of the sketches of Delacroix, duly authenticated by the stamp of the studio, and which at the end of his sale were appraised at ridiculous prices? How does it happen that they no longer turn up, while the small canvases of the master have so greatly multiplied? May they not have been finished as paintings?

As for prints, we shall not speak of them. There pass through the custom house every month as many English engravings in color and as many works of the minor masters of the eighteenth century as England and the eighteenth century were able to produce. But no one is ignorant of the fact that, for the printing of these, the presses at Berlin run day and night. Here, it is said, a factory worked for a long time for the sole purpose of increasing the collection of the city of Paris with documents upon Madame de Sèvigné and her relatives and friends, and upon the French revolution.

We should like to draw a few conclusions from all this. We certainly must not look for manufactured articles everywhere; but there are many of them in the oftenest mentioned collections, and even in museums. All this is not of great importance when it is a question of collectors who foolishly amuse themselves in duping one another; but it is an entirely different matter when the state is concerned, and when a functionary's errors, as honest as they may be, are paid for by those who are subject to taxation.

It would be well, in the first place, to cease attributing to the antiquity of an object the value that is set upon it, beauty being the prime merit of a work of art. We should become persuaded, in fact, that, since the time at which they were sought for, all the authentic things of beauty exhumed have become known and have their nest made, and, on the other hand, that the skill of counterfeiters is so great that the most experienced scientists are put to rout before their productions.

Finally, let it be said that at no epoch has there been more manual dexterity, more genius, more talent, and more ingenuity than at present; that we have wonderful artisans and artists; and that it would perhaps be wiser and better to encourage them and collect their works than to encourage brokerage, since it is the latter alone that puts our simplicity to profit.—Translated from L'Illustration, for the SCIENTIFIC AMERICAN SUPPLEMENT.

HEATING AND VENTILATING OF RAILROAD AND OTHER SHOPS.

AT a recent meeting of the New York Railway Club an interesting discussion took place upon the subject of

THE LYCIAN APOLLO.

Restorations: The hair and forehead, the nose, the mouth, the chin, the neck, the arms and hands, the right thigh, the legs, the feet, and the tree with the serpent.

heating railway shops and other one-story buildings of the same nature. While such buildings are very simple in construction, they are not so simple as might appear in regard to the problem of effectively and efficiently distributing heat and air. On account of the large amount of roof, wall, and window surface, the loss of heat is very great, and also, because of this and the relatively great height of the building considered as a single room, there is a tendency toward unequal distribution of the heat, the warm air rising to the roof and the cold air flowing to the floor, where it renders the workmen uncomfortable. It is important,

ATALANTA.

Restorations: Hair to the right and left of the knot behind right ear, part of the eyebrow and of the left eye, chin, mouth and base of the nose with a portion of the cheeks, base of the neck and part of the baldric, two pieces of the right shoulder, forearm, hands, poignard and scabbard, tunic, thigh, leg, left foot, plinth and tree.

then, not only that a sufficient quantity of heat should be delivered to the building, but also that it should be delivered where it will do the most good.

If an attempt is made to supply the heat directly by means of steam or hot-water coils, the best results are not obtained. The vicinity of the coils is apt to be uncomfortably hot from the heat radiated directly therefrom, while places at a distance are disagreeably cold. The heat transmitted to the air of the room by contact and convection from the coils is largely lost, since the hot air rises vertically and imparts its warmth to the roof and skylights. A further objection to this system of heating is that it makes no provision whatever for ventilation, the extended system of steam or water pipes is subject to damage by freezing during the coldest weather, and steam pipes have been shown to be frequently the cause of fire where they came in direct contact with wood or other inflammable materials.

Due principally to the reasons which have been given above, the direct system of heating for work of this character is falling into disfavor and is being superseded by the fan or hot-blast system. The apparatus required for the latter consists usually of a steam coil for heating the air, an engine or motor-driven fan for propelling the air through the heater and to its destination in the shop, and a system of piping or ducts leading it where it is needed. The heater will contain a considerable less length of pipe than would be required for direct heating, due to the higher velocity of the air over the pipe surfaces. The blower is additional equipment, but its use would be justified on the score of ventilation alone, something which is hardly considered at all in the direct system of heating. The exhaust of the engine is usually turned into the heater, thus obviating any loss from that source.

The distribution of the air by means of pipes should be so carried out that the lower part of the room is kept at a comfortable temperature, while at the same time no disagreeable drafts are produced. It has been found that by properly proportioning and directing the delivery flues, most satisfactory results can be secured. Illustrating this point some very interesting examples were cited at the meeting mentioned above, by Mr. C. H. Gifford.

He said: "As an example of what can be accomplished by distribution, take that of the New York Shipbuilding Company, whose machine-shop is not dissimilar to one designed for railroad work. They have a building which is about 1,100 feet long, about 250 feet wide, and 82 feet high. The proposition was to heat one-half of this building and leave the balance of it unheated. It was a problem that came to me, and I must say that I was a little baffled at attempting to heat one end and not have any interference from the other end. We, however, conceived the idea that there could be a partition put across the middle of the building about 12 feet high, and we could then bring the heated air down to the zone which it was desired to heat, which was not over 8 feet above the floor, and in that way we could perhaps confine the air in the space, and not have very much effect on the rest of the building. It was something of a speculation and rather a bold attempt, when you consider entering into a guarantee which might involve a serious loss; nevertheless, it was done.

"The apparatus is arranged under the landing platforms of the gallery which surrounds the shop, so that it is out of the way of the cranes. Pipes are carried along beneath the runway of the cranes, and branches are brought down on the posts and discharge the air toward the floor, the outlet being in the form of a Y, which is adjustable.

"We were very much gratified after the plant was started to find that it performed just as was expected it would, and it is surprising to note the difference in temperature between the two sides of that partition; it is almost the same as when you pass from the building out of doors. The result is simply due to the fact that the air was brought down and continually pressed down into the space which it was desired to heat."

The adoption of the fan system renders the control of the heating apparatus and of the ventilation ideal. During very cold weather, or in the morning when the building is being heated, the air supply may be drawn from within the building itself, thus effecting a great economy of heat. In some buildings having a very high cubic space per occupant, sufficient ventilation during the winter time will be supplied by the leakage of air through doors and crevices about the windows, by transfusion, etc. Quoting another advocate of this system, some of these advantages are as follows:

"First, a great convenience in handling, since the entire heating system of a building may be controlled from one point.

"Second, efficiency and economy, by controlling the speed of the fan and reducing the length of pipe to which steam is supplied, leaving more steam available for other purposes.

"Third, the fact that the entire heater coil is in a steel housing makes the danger from fire much less than with many pipes passing through partitions of wood.

"Fourth, in the summer time it gives the opportunity to ventilate the shops.

"This is quite important. Some shops are very apt to become overheated in the summer time, and a current of cold air may be drawn from a basement, making them much more habitable.

"The pipes should be so arranged that the air will not be discharged directly upon the workmen; it is also true that hot air will do the most good if it is put where it is needed. If the space around the walls of a building is properly heated, one may never worry about the center, as that will keep warm.

"It has been found, therefore, that the most satisfactory heating will result from numerous pipes discharging on the outside walls at a point about 6 feet to 8 feet above, and directed toward the floor. These pipes should be located from 25 feet to 40 feet apart, depending upon the character of the building. This arrangement causes hot air to be blown downward, whence it spreads on the floor, keeping it warm before the air has a chance to follow its natural tendency and ascend to the roof. Hot air has a very bad faculty of getting up in the trusses, and if you blow the air directly at the floor and get the floor warm, at the same time keeping the outside of the building warm, your problem is practically solved. In the case of an underground duct, it is well to use short outlet pieces which will discharge the air along the walls at the floor.

"At the works of the Fore River Ship and Engine Building Company, they have an overhead pipe system with drops on the walls, which was put in according to the regular practice. Later they added fifty per cent to the building and are now heating it with the same apparatus. That is, a fan heater was picked out which was considered to be the proper size for that particular building, and it worked in a perfectly satisfactory manner. Later the ship company added fifty per cent to the length of the building. The piping was extended and drops were carried on the walls every 30 feet, which blew the air on the floor with ample outlets on the ends, and in the coldest weather the heat of the building was perfectly satisfactory to them.

"At the shops of the Atchison, Topeka & Santa Fé Railway Company, the underground system is used, and low horizontal outlets are provided, which distribute the air at the floor and along the walls. This

THE VENUS OF ARLES.

Restorations: End of the nose, base of the neck, two pieces of the left ear, flowing part of the bandlets on right arm, the right arm, and the two forearms.

is an extremely large shop, the contents being about four or five million cubic feet. The shop is heated by four large apparatus, and the underground ducts extend almost entirely around the building. The pipes are not over three feet high, the air being discharged

horizontally along the floor, and I understand that the building is very satisfactorily heated.

"The following general classification of railway shops may be made: First, machine, erecting, and car shops; second, paint shops; third, round houses.

"The second and third require special treatment. Paint shops require to be practically dustless, and, consequently, the air velocities must be low. The temperature requires to be higher, and it is customary to arrange to circulate the air in a much more thorough manner than in shops of the first class.

"This is done in the Pennsylvania Railroad shops at Altoona by means of ducts, and in the New Haven shops, Readville, by a similar overhead system. There has been a great deal of hesitation among railroad men about installing the hot-blast apparatus in paint shops. They are afraid of getting their varnish dusty. But I might name a dozen or so paint shops all over the country, for instance, the Boston & Albany shops at Allston, the New Haven shops at Readville, and there are several Western shops, all of which are heated with the hot-blast system by a very ample distribution of air. The circulation is brought about by a counter-exhaust system, which circulates the air, returning the whole or a part to the apparatus. There are two ways of establishing this return of the air, one by an underground duct system, and the other by an overhead galvanized system. In the Pennsylvania Railroad shops at Altoona the air is returned from underground and back to the fans, using very ample distribution of air-pipe in the discharge. In the Readville shops the air is brought back by means of an overhead galvanized pipe. In this way circulation is kept up in all parts of the room, and thereby the paint is dried much more rapidly than it would be by any other system where the air in the room is practically still.

"Round houses have been much neglected up to recent years, but of late they have been receiving better attention. Their proper heating is a problem of no little moment.

"The hot-blast system of heating is a great improvement over the old method, since it allows for ventilation in the winter time with both windows and doors closed. In this class of buildings the air should be delivered through ducts which terminate in the walls of the pit, thus delivering the air where it will be most effective for thawing out engines that have come into the house covered with snow and ice. At the same time it is a very good idea to have a provision for admitting some of the air above the floor in case there are no locomotives which need special attention."

DOMESTIC LIFE IN INDIA.

By JOHN DAVID REES, C.I.E.

IT was the often-quoted Marcus Aurelius who said, "Improve things a little, and do not consider such a result of small importance," and it is only with some such maxim in his mind that anyone more or less familiar with Indian manners, customs, and languages can venture to address an audience like this on such a subject as domestic life in India. It is so vast a theme, and admits of so many aspects, that nothing but a conviction that the aspect most perseveringly offered to the English public is unjustified of the facts would support the individual in his endeavor. That India is a continent occupied by many races speaking many languages is a fact only imperfectly appreciated in England, and it may easily be imagined that women within its borders differ in different parts of the Empire as much as the hardy and laborious housewife in Finland differs from the ease-loving and lazy daughter of Southern Italy, and that their homes exhibit no less variations from what may be considered the standard type.

But as a common Christianity imposes standards possessing some similarity in their ideals, if not in practice, upon all the inhabitants of Europe, so does the Hindu, the caste or the Brahminic system conduce to the acceptance right throughout the wide extent of the Indian empire of common standards of life and conversation. It would be extremely easy to show the wide variations from this caste Hindu standard which obtain among many tribes, races, classes, and sects, but throughout all these variations, even where certain customs absolutely repugnant to Hindu ideals exist, the scheme of life upon the whole will be found to be fashioned upon that of the caste Hindu or Brahminic system.

It is as well at the outset to realize that Hinduism is caste, and caste is Hinduism. The terms are, in fact, of equal value and significance. The 1901 census reports of various provinces, which have just been received, are the latest and most authoritative accounts of the present condition of different parts of the Empire. The superintendents, able men selected for this duty on account of their special qualifications, when they have to define Hinduism in the interesting chapters relating to religion, agree in saying that so long as a man observes caste rules, he may not only do pretty much as he pleases, but may actually offer his individual worship to any god or hero, any stick, stone, river, hill, or natural feature, which his own inclination, or the animistic traditions of his village have endowed with supernatural attributes of a protective or destructive character.

This is no discovery, but it is probable that even in this hall the audience which recently heard a distinguished Indian gentleman describing caste, which he had abandoned, as the root of all evil, hardly realized that caste is Hinduism, that to condemn it is to condemn our Indian fellow subjects, to actively work for its destruction is to run counter to Queen Victoria's proclamation of 1858, and the solemn pledge it contained to guarantee to the natives of India their own customs and their own religion. An accomplished Bengali author, Mr. Ghose, recently published the life of Maharaja Nabkissen, a friend of Clive, who helped us in our early days in India, more, perhaps, than we have ever acknowledged. Mr. Ghose sees "in the English conquest of India, more than in any other event of equal importance, a divine dispensation." The founder of the Brahmo Samaj, Keshab Chunder Sen, whose new religion was a revolt against caste, the most binding law of which he none the less observed in his family life, used much the same language, but without adding, as Mr. Ghose does, that there is no fear of our rule going wrong, if we remember the principle of Queen Victoria's charter, and if in carrying out innovations we follow the English method, not of revolution, but of evolution.

Our legislatures in India have none the less, since the precedent of the abolition of *Sati*, with which no other Indian customs can compare, passed acts which are revolutionary in character, and might have tended in some measure to produce discontent, but that they have fallen stillborn from the legislative womb, like the untimely fruit of those premature marriages, against which reformers, not indeed without reason, if without measure, rail, but which, as a rule, they practise in their own family circles.

These remarks are merely introduced for the purpose of showing that the Hindu domestic life is a caste life, of which indeed we are all entitled to hold and express our opinions, but from endeavoring to destroy which, we are precluded by a sacred engagement. An anti-caste attitude is an anti-Hindu attitude, and if it provokes discontent and reprisals, we have no more right to resent such manifestations, indeed we have far less right, than we have to complain of criticisms and condemnations of ourselves and of our methods, which we do not altogether appreciate, and indeed do not deserve, on the part of our European neighbors.

It is necessary then, in looking at a representative Hindu family, to look at its caste aspect, remembering that, while domestic life differs in many parts of India from these standards, they are the ideals to which all respectable and self-respecting families approximate, or which they will consciously or unconsciously aspire to imitate.

The south of India and the Deccan is that portion of the continent in which Hinduism may be studied with the greatest advantage. Mohammedan rule and customs herein never took root. Even in Hyderabad the people are Hindus, and the Mussulman lords and their followers a mere handful, while on the southwest coast there are Native States, which are completely unaffected by the Mohammedan conquest, cut off as they are by the sea and the mountains from all invasion, and from all foreign influences.

The extent, however, to which Mohammedan customs have affected other parts of India is habitually over-estimated to an enormous and unpardonable extent. It is as easy to over-rate this effect as it is difficult to exaggerate the influence Hinduism has had upon Islam in India.

To take a Hindu home in a village in Southern India, the anglicized Hindu's house in the Presidency city being hardly more representative than that of the foreign immigrant. In the first place, the site must be chosen and the house built according to caste rules and the science of domestic architecture; and there are auspicious months in which to build in India, just as in England in which to marry. In rich houses the chief entrance is called the lion gate—like one of the gates of Kew Gardens—and it is sometimes elaborately carved. The beams and posts are apostrophized, hymns are chanted, saffron, turmeric, and sandal are smeared upon them, flowers are offered, and whether, in fact, the ceremonies are looked upon as differing very widely from our deposit of coins and newspapers, speechmaking, and trowel presenting, no one can say. It is enough that custom prescribes certain ceremonies. The house, and the mere hut follows suit, is one or more quadrangles with one or more open courtyards, and sun and rain must have access—a good rule, and one which would be better if there were but added a drain. A blank wall is offered to the street, and around the inner quadrangle runs a veranda, to the southwest of which is the kitchen. In marked contrast with the dark and impenetrable annex to the luxurious bungalow of the Anglo-Indian, in which an utterly casteless cook prepares in some absolutely and fortunately unexplained manner an excellent, but, to the caste Hindu, unmentionable dinner, the kitchen is the most sacred part of the house, and, in fact, combines the characteristics of a chapel and a cook house. A Christian place of worship may be smaller and lower than the house of the owner in India, as in England the tower of the house may top the spire of the church, but in an Indian house no part should properly be higher than the kitchen, into which no person of lower caste than the owner may so much as look, far less enter. A Brahmin may cook for a master of lower caste who pays him, but if his master looked inside his kitchen, in such a case the Brahmin would not touch the food. The bed and other rooms open into the inner veranda, in which cows and calves are also often stabled. No Christian should take fright at this custom at any rate, and different as is their religion, the home life of the Hindus repeatedly recalls and illustrates the Bible narrative of the origin in Asia of our own religion. Of furniture there is little, and when a Hindu has a grand home after the Western fashion, the furniture of the apartments he actually uses consists of pots, and pans, and brazen vessels, and possibly a chair or two, and a simple bedstead, called the "four-legs," with broad webbing, which is really as comfortable as any which Maple or Hampton can supply. The married sons generally live under the paternal roof, which is very elastic, as any male can sleep anywhere on the floor. This sounds uncomfortable, but a bed a head is by no means the rule all over Europe. Indeed in Russia men servants often sleep about anywhere in great houses, and even guests in country places. There are sometimes a few flowers, and always an altar containing a shrub of sacred basil. The house-owner does not get installed without a good deal of ceremony, and a certain amount of expense, which corresponds, perhaps, with our house warming.

Let us, following the principle above enunciated, suppose him to be a Brahmin, and at length installed. He must rise before the sun and pass some time in contemplation, repeating to himself texts from the Puranas:

"Rama! thou givest all good things,
Who, but thyself, deliverance brings,
Thee with one voice we all adore.
Ah! let me praise thee more and more."

Then follow rinsings of the mouth, washing of the feet, cleansing of the teeth with a piece of stick never to be twice used—women use the finger—then the bath in river tank or well, next prayers, oblations to the sun, more prayers, the fixing of caste marks on the now purified person, salutations to the different quarters of the compass, oblations in honor of ancestors, and repetition of the sacred Sanskrit text:

"Hail earth and sky, and heaven, hail kindly light,
Illuminator of our purblind sight."

There are more prayers before the midday meal, and these at least are a counsel of necessity, and are attended with further ablutions, the wearing of clean cloths, and more prayers and oblations, bathing of the images of the gods, offerings of clarified butter, flowers, and a portion of the food. Then the male members of the family sit on the floor, and eat their rice or other grain with pickles or condiments, off plates made of plantain or other leaves. Food is eaten with the right hand, and water poured from a vessel held in the left hand right into the mouth, neither vessel nor water touching the lips. The latter must have been drawn and fetched from the well by a person of good caste. There is a great prince in India who can only drink water given to him by a particular Brahmin, and once he suffered greatly when this necessary and important functionary was unavoidably delayed on his way to the palace.

Very much the same prayers are repeated at eventide, but the gods are not again bathed and worshiped before the evening meal is taken, about the same time as the supper which in our artificial life, with its injurious and unnatural late hours, it pleases us to call dinner—a term more usually applied under simpler conditions to the midday meal. These prayers and ceremonies are really less long and irksome than might appear, and on journeys and during illness they are necessarily abbreviated. There is no custom of regularly visiting the temple, corresponding with our habit of going to church, though worship is performed by the officiating priests daily, without fail, as in one branch, at any rate, of the Christian Church. Upon holidays and festivals, however, people worship the gods in the temple with flowers and fruit. As for the women, they should worship their husbands, and, in company with their husbands, the gods; but the production and nurture of children and the care of domestic affairs is their peculiar sphere. It is probable that women, who confine themselves to these two duties, are not inferior to others whose energies are more divided. At any rate, Hindu literature and history afford frequent examples of heroines, who would do credit to any clime or country, and who were honored by their own people with every mark of extravagant affection and esteem. Sita, the wife of Rama, is the Indian Penelope, and allowing for poetic and traditional exaggerations, her standards of life and conduct are such as Indian women very generally maintain—

"As the shadow to the substance, to her lord is faithful wife,
And she parts not from her consort, till she parts with fleeting life."

And women have in fact their daily prayers, translations of which I myself made for Queen Victoria, and a wife is a necessary part of certain ceremonies performed by her husband. In daily life, she rises before him, cleans the house, and particularly the kitchen, singing hymns the while. Next she bathes, and puts on her forehead the mark of her married state. Cooking occupies her till midday dinner time, and before her own meal, which follows after that of the men, she says a simple prayer accompanied by prostrations, offerings, bell ringing, and circumambulations of an image, perhaps of the goddess Lakshmi. Of course, in the cultivating classes, women help freely in field labor. At night again when the lamps are lit, she makes obeisance to the god of fire, saying:

"This flame proceeds from God above,
This lamp is lit by heavenly love;
So praise we, when each night begins,
The fire flame which burns away our sins."

I hope and believe that good Hindus will forgive my rough rhyming translations of their sacred Sanskrit texts, in consideration of the respect I have for their lives and their characters. As to the worship just described, I have seen the head of the house in holy Russia go through almost identically the same ceremonies before the eikon in the angle of the wall, and except that he knows he is "orthodox" and no one else is, which is exactly what the Hindu thinks, I doubt if his religious beliefs are necessarily of a higher order. At any rate, assassins have prayed to eikons for success in their undertakings, and if thugs in India did the same, they were no more representatives of true Hinduism than the worst of its orthodox children are of the Greek Church.

One of the greatest authorities on the Hindus, Ward, says that "a husband may enjoy heaven as the fruit of his wife's virtuous deeds, and if he die first will suffer for the sins of his wife," in short, their good deeds are transferable, but the Hindu authorities of the present day are not very clear on the point whether a good husband can save a bad wife. All agree that after her husband's death she can hasten his final absorption into beatitude by her prayers and penance, a doctrine apparently not widely distinguishable from that of the elder branch of the Christian Church, which Hinduism also resembles in its more rigorous fasts. This is pure Hindu doctrine, and the lower we descend in the scale the less provision is there made for women's rights, in this world and the next. In the lower castes the actual worship is rather demonolatry or animism, where daily ritual amounts to little more than an obeisance to the sun in the morning and the lamp at night, except during epidemics and festivals, when the idol in the temple, or the fetish in the field or beneath the tree, is propitiated with offerings of fowls, fruit, food, or flowers. In the people of India a belief in transmigration coexists with the creed that during one life the individual is unconscious of a former existence, which must largely discount the value as a penance of a term spent in the guise of an unclean or unfortunate animal. In fact, it is no part of the theory of transmigration that any such consciousness exists. To the

inquiring European Hindus are shy of communicating much information on this subject.

The Hindus, though they present a solid front to non-Hindus, are divided themselves into Nondualists, believing nothing has any real separate existence from the one God; Dualists, who allow that the human soul and the material world have a distinct existence, and the Nondualists, who yet ascribe to the Deity a form and quality, giving him a twofold aspect—the Supreme Spirit the cause, the material universe the effect. While these distinctions interest the learned, ordinary people are content to worship Siva or Vishnu, the latter cult having more than one sect. All this recalls the vain disputes which centered round the ὅμο and the ὁμοιούσια. Unfortunately the course of study at our colleges and universities includes and encourages philosophy, so that not a little harm is done by confirming the tendency of Hindu youths to waste their time in studying vague problems, such as learned triflers were wont to waste their time in discussing in Europe. The outward and visible signs of the sects are a trident for Vishnu, and one or more horizontal lines for Siva, and without these marks food must not be eaten nor acts of worship performed. The wife generally wears a red spot upon her forehead. Had the Christian missionaries allowed converts to retain these marks, the topknot, and other signs and observances of caste, the conversion of the country would have more nearly approached the region of possibility. The Roman Catholic missionaries, who led off with great successes, saw this, and so long as the controversy known as that of the Malabar rites was not decided, against what the purists called trifling with idolatry, they had a fair hope of the wholesale conversion of the extreme south at any rate of India, on the west coast of which there are still some, and they are practically all the high caste native Christians, who retain for the most part their caste, and a corresponding position in Hindu society. The English might have passed for a high caste, with all its inestimable social and political advantages, had they not, apparently, made a point of engaging Pariahs as their servants. All Indian questions are caste questions, and these are matters of the first importance. No Englishman who turned Hindu would be accepted as an authority, even by Hindus, regarding the religious and social characteristics of the people he had forsaken, if indeed he got a hearing at all. Mrs. Besant does not lecture to Hindus on Christianity, but on Hinduism; but here, in England, the authorities accepted of the public and the press are generally those who having been, have ceased to be, Hindus. In such cases were they angels from heaven they could hardly be other than steeped to the lips in prejudice. Is not an ancient civilization entitled to a fair hearing, a faith professed by millions to respectful treatment, a law-abiding and loyal people to an unprejudiced judgment? Yet they often fail to obtain bare justice, and are condemned off-hand on an individual, and necessarily interested, representation.

Controversy rages around the marriage of the most married peoples upon earth. Whether or not and to what extent maidens chose their own husbands in Vedic times is a matter of little importance; their parents now choose for them, as is done, it may be observed, in most European nations, though not in England. Although girls need not be married till they are of a marriageable age, the absolute necessity among Brahmins and their imitators of finding a husband of the right caste or division of caste before the girl reaches that age, leads to their being betrothed when small children, the betrothal being a binding ceremony. The advice given in the institute of Manu is often quoted:

"Let a man not marry a girl with reddish hair, or deformed limb, nor one troubled with sickness, nor one with too much or too little hair, nor one immoderately talkative. Let him choose a girl whose form has no defect, who has an agreeable name, who walks gracefully like a young elephant, whose hair and teeth are moderate in size and quality, and whose body has exquisite softness."

Let those who know the elephant in the Zoological Gardens laugh; those who have watched free herds in their native jungles can see that the sage's eye was not altogether in fault.

Polyandry is rare in India and only practised by a few degraded tribes, for the Nairs of the Malabar coast by no means deserve this reproach. True, a Nair woman can change her husband, but she may not have more than one at a time, nor does she exercise the privilege of making a change without good reason under pain of loss of reputation. Similarly, polygamy is permitted to Hindus, but their instincts are monogamous, and they rarely and regretfully take a second wife, unless the first has no surviving male issue, when the paramount religious necessity for having a son to perform the father's funeral sacrifices, renders an adoption or a second marriage obligatory. Even in that case the first wife should consent, but she is often the first to urge the step, and seeing what her object is, this can only be to her credit. No doubt questions of dowry enter into Hindu marriages; but are they unknown elsewhere? Are such negotiations everywhere based solely on the interests of the young couple?

"How many a noble father since Agamemnon sinned
Has sacrificed his daughter to try to raise the wind!"

At any rate, anything like selling a young daughter to an old man for money is not only against the spirit, but is contrary to the letter of the Hindu law, and human nature varies in India as it does elsewhere in brides and bridegrooms and their parents. It will astonish some to hear it, but it is roundly asserted that English education has increased this abuse, since large sums are now offered as dowry for youths who have the degree of B.A. and M.A., who may be expected to secure the coveted post under Government.

The marriage ceremonies are infinitely complex, long drawn and costly, as unduly costly, perhaps, as funeral ceremonies in England, in proportion to the means of those who incur them, but more justifiable, since the occasion is one for rejoicing. Houses are decorated and enlarged with temporary additions, and the ceremonies last about a week. A description of them would not, I think, greatly interest my audience, but they include praying and eating and drinking, and the exchange of presents. When the actual giving of the maiden takes place, the groom is asked if he is willing to take her to wife and on his assenting, his garment and that of the bride are knotted together. This is a very important symbol, and in Malabar, where marriages are bereft of all the usual attributes, the giving of a cloth none the less is obligatory. The father declares his willingness to give the girl to be the groom's wife, hands are joined, a libation of water is poured, a gold ornament, corresponding with our wedding-ring, is tied around the neck, after which all those present throw colored rice over the newly-wedded pair, who, with clasped hands, walk three times around the sacred fire. Hymns, of course, are sung, and husband and wife eat together—the only occasion, for subsequently she eats after her husband. There is also a great deal of feasting and a procession, attended with much pomp and music. The bride, who, in the case of rich and respectable families, is never of a marriageable age, remains with her parents till she grows up, and further ceremonies take place when she joins her husband. Among the lower classes and castes there is, unless the family happen to be rich, less ceremony and less feasting, but as far as may be they follow the lead of the Brahmins.

Apropos of feasting, whether or not in the Vedic epoch, the whole animal and vegetable system was available for the sustenance of man as appears from the Institutes of Manu to have been the case, the higher classes now are, as is well known, rigid vegetarians. The census reports of 1901, agreeing herein with that excellent authority, Mr. Crooke, attribute the greater strength of Mohammedans and their greater relative increase in numbers, in part at least to their habit of eating meat, but there are excellent reasons for holding that a vegetarian diet, which connotes to a great extent abstention from alcohol, is more wholesome in the Indian climate, and it is fortunate that this is the standard to which the lower classes, who may and do eat meat, when they can get it, are apt to approximate, and still more fortunate that the cow, which gives milk and butter, and the ox, which draws the plow, were declared sacred by the earliest authorities. The Hindu's table is not, however, badly supplied, and I have myself sat bewildered and wholly unequal to the occasion among a multiplicity of vegetarian dishes of every variety of flavor, astonished at the number of chutnies, pickles, butters, sauces, which are available, all prepared by the ladies of the family, every one of whom is a well qualified stillroom maid.

As with food so with drink. The Hindus have always taken alcohol, but the use of it is looked upon as degrading and characteristic—as it actually is, except perhaps, among the English-educated—of the lower classes. Upon the whole, it may be said that temperance is as distinguishing a mark of the Hindus as intemperance is of certain European nations, though cheap liquor is easily procurable and the climate is hot and enervating. There is no nation more temperate in its own tastes, and more tolerant of those of others, than the Hindus.

Besides dinner and supper, the recognized meals, with which, polite as he is, the Hindu will hardly suffer other calls to interfere, a light early breakfast of cold rice or cakes is generally taken, when, as always happens with the masses, the early riser gets early to work. Coffee is sometimes taken, and hopes are entertained that a morning cup of tea may become as usual among the people as it is among the Europeans in India. The Hindu traveler suffers much inconvenience in keeping his caste rules, but the ever-ready hospitality of the country comes to the rescue. To feed the wayfaring son of the road is a religious duty. In the Institutes of Manu it is written—

"Who sends the stranger hungry from his door,
That stranger's sins are added to his score;
Who entertains a stranger, though his sins
Are red as scarlet, he salvation wins."

An attention to sanitary considerations, which in other respects, it must be admitted, is not always present, partly inspires the odium which attaches to Pariahs, who eat carrion. It is because they employ servants of this caste that Englishmen are denied privileges enjoyed by Mohammedans and Hindus of all castes, other than Pariahs, whom, it will be observed, Mohammedans will not employ. The position occupied by the Mohammedans as caste men in the eyes of the Hindus would have been to the English a valuable political asset, which they will now never possess.

It is characteristic of the kindly nature of the Hindus that their new year's festivities extend to the cattle, who are given a rest and a feast. Upon the Naga festival, offerings are made to the cobra, as the king of the snakes, whose worship in one form or another, and to a greater or lesser extent prevails all over India. Indeed, on the Malabar coast, a cobra corner is looked on as one of the amenities of the separate walled-garden houses which usually are found in that favored region. Upon Ganesha's birthday, the god who removes obstacles, a fat and friendly deity, artisans perform *puja*, or worship the tools of their trades, and students to their books, a very practical form of prayer. During the Durgapuja or Dussera, riots often occur between the Hindus and Mohammedans. In Southern India serious objection was taken to Hindus "putting on appearance of tiger," the man tiger in buff and black stripes being looked on as a special attribute of the Mohammedan commemoration of the martyrdom of the Prophet's grandson, Hussein. I have, myself, had to deal with quarrels arising out of this point of procedure. Every full moon is holiday, and sea bathing with the Hindus, as with us, though we attach to it no religious significance, is considered necessary at certain seasons of the year.

Unfailing charity is a well-known attribute of Hindus, and the comments made two years ago on their subscriptions to the public and semi-official famine funds, took no account of the fact that they were already, and had long been, supporting the famine-stricken to the utmost limit of their means. The Hindu not only supports his relations, but also the poor scholar, for—

"Heaven's gate is near the sinner
Who gives the humble scholar dinner."

No doubt their charity is abused, and sturdy beggers presume upon it, but is the administration of our poor-rate free from the same reproach, and is the money compulsorily collected and voluntarily contributed in England, so distributed as to relieve in fairly equal measure those in real want? Both systems are subject to serious abuses, but the spirit underlying that which obtains in India is at any rate worthy of all praise.

(To be continued.)

THE TREATMENT OF OLIVE OIL IN FRANCE.

THE manufacture of crude olive oil in Europe has undergone comparatively little change since Scriptural times. The olive tree gives a good yield of fruit every two years, which is gathered in France in either November or December. In Italy, the picking season is in either February or March. The rule is to collect the olives before their maturity, without which they fall, become bruised, and give an oil green in color and sharp to taste. Gathered too long before their maturity, the oil extracted has these same disagreeable qualities, and it is therefore necessary to recognize with certainty the proper moment for taking them from the trees. At first green, they become yellow, then red, and finally reddish brown, at which point they have arrived at the desired state of maturity. The olives found upon the ground are placed aside, and the trees are then shaken, in order that the completely ripe fruit may also fall and be put apart. The oil extracted from these olives is of inferior quality and has the flavor of the fruit itself. The olives remaining upon the tree are either picked by hand or beaten with long poles. The latter method is discountenanced, as the fruit is thereby necessarily bruised, with disastrous consequences to the oil, and the trees themselves give a less abundant yield thereafter. This system is so expeditious, however, that in a large proportion of cases the trees are beaten and the fruit falls into sheets held beneath for the purpose. An olive tree ten years old should yield about 6 pounds of fresh olives, and at twice that age twice that quantity, and at the age of fifty years from 22 to 26 pounds.

In the south of France and in Italy, the crop of olives is gathered in large sheets and transported to warehouses or cellars, and there laid in beds 6 to 8 inches in thickness. They remain for from twenty-four to forty-eight hours, until they commence to wrinkle and lose a little of their water, but not sufficiently long to permit fermentation to begin. In other countries, and particularly in Spain, the habit is general to store the fruit in piles, where it remains for from twelve to fifteen days. A black water is drawn from this mass, which heats and ferments. Before the fermentation proceeds too far, a point which is decided by thermometrical test, the manufacture of the oil begins. The piles should not exceed 6 feet 6 inches in height. The extraction of oil from olives thus manipulated is easier than otherwise, as the cells containing the oil are less resistant, but the oil has a strong odor and is less desirable than that of more carefully handled fruit.

The manufacture of the oil, properly speaking, begins with the crushing of the fruit, which usually takes place in an old-fashioned mill, although some excellent crushers are manufactured. The crushed fruit is placed in round mats, of which twenty-two are usually placed one above the other, the weight of olives ranging about 165 pounds. The first pressure being applied for the virgin oil, the oil and water drain into tubs, the proportion being 72 per cent of water and 28 per cent of oil. The virgin oil is set aside, and the mats, removed from the press, are bent back and forth by hand, some of the manufacturers pouring a quart of hot water upon each mat, after which the twenty-two are placed in a hand or hydraulic press and the second pressure applied. The oil and water are drained into tubs, as with the virgin oil. The pulp remaining in the mats is removed, and by simple mechanical process, which takes place in a separator, the kernels are separated from the pulp, from which latter a third and very low grade of oil is obtained by chemical process. This process is rarely carried on by the olive growers, as it requires complicated apparatus. Both pulp and stones have a regular market price, however, and are manipulated in Marseilles on a large scale. The local cultivator occupies himself with the first and second crushings only.

The oil in the tubs, as it comes from the press, is carefully skimmed and placed in barrels. After all the oil of the surface has been skimmed, apparently, the water itself is poured into stone or tile cisterns, called the "enfer," where it remains three or four months. In the course of this period, a considerable quantity of oil in suspension mounts to the surface, and is also skimmed off and sold as "huile d'enfer." Its odor is very strong and the price is low. The oil of the first pressing, or the virgin oil, and the oil of the second pressing are always kept separate and sold for what they are. They are decanted three or four times from one barrel to another, and finally deposited in huge earthenware jars, where they remain until spring, and are then decanted for the last time into barrels and offered for sale in the market.

The successful manufacturers and exporters of olive oil find their raw material wherever they can, having buyers who scour France, Italy, Spain, and Tunis, and the success of the business hinges mainly upon the tasting capacity of the head of the house, whose work begins after the oil has been pronounced upon by chemical analysis. Probably the largest institution of this kind is the establishment of Adolphe Puget in Marseilles, which has been in existence for almost a century, having been handed down from father to son. Mr. Puget himself is the mainspring of the institution, which does not suffer by comparison with any manufacturing establishment with which I am familiar. The walls of the main room are decorated with helpful mottoes, and a portrait of the founder of the house occupies the most conspicuous position. Extreme consideration for the employes, from the most humble to the most high, is one of the controlling principles of the proprietor, and a degree of enthusiasm is obtained from the working force which is as unusual as it is refreshing in this country. Next to the perfect order, the most striking characteristic of this oil factory is

its absolute cleanliness, a merit which is all the more striking because of its extreme rarity in these southern countries. Mr. Puget has very recently installed a complete line of can-manufacturing machinery of American make, and in every department of the organization he has established the most perfect devices that money can buy.

The oil received by this manufacturer is discharged from barrels into a series of huge subterranean tile-lined tanks, and this portion of the building is so constructed that the variation in temperature is almost insensible from one year's end to another. As marks of oil are shipped from this institution which have been in continuous existence for over fifty years, it is of the highest importance that, although the olive crops vary from year to year, there shall be no discernible difference in the flavor of the oil of a given mark. To guard against any difference in the flavor, the crude oil is purchased in immense quantities and the proportions mixed in these large storage tanks with such nicety and prevision that consumers never realize the infinite pains requisite to maintain the standard. From the large tanks the oil is forced by hydraulic pressure through paper filters and then pumped into tin-lined tanks, from which it is drawn into bottles and cans for export. No mystery is involved in the manipulation of the oil. It is simply a matter of experience, involving the purchase of good oil in the first place, cleanliness in handling it in the second, storage in a dark and cool receptacle, hermetically closed, and, finally, packing it with scrupulous care in bottles and cans. But even with all these precautions, Mr. Puget tells me that the very best of oil, handled under the most favorable circumstances, will show signs of deterioration within two years at the latest.

The most important operation in the treatment of the crude oil is its filtration. While the various nut and seed oils are now readily freed of the margarin in suspension by subjection to a low temperature, this process cannot be successfully followed in the case of olive oil, which is a much more delicate product. Until comparatively recently, the packers of olive oil filtered it through cotton, and probably the majority of packers cling to the old system, mainly because of the expense of the improved paper filters. Excellent results are obtained by passing the oil through cotton, but the process is slower, and the cotton itself absorbs large quantities of the oil, which cannot be expressed and used, except as an inferior product. It is now generally agreed that no more satisfactory filtering material has been found than specially prepared paper, and the oil is passed through paper either by means of force pumps, hydraulic pressure, or the application of the standpipe principle, the pressure upon the paper depending upon the height from which the oil is injected into the apparatus. The best filter on the French market to-day is manufactured by A. Capillery, who may be addressed at Le Vigan, Gard, France. In a communication Mr. Capillery says:

"My apparatus filters automatically, involving no expensive installation, and its work is irreproachable and speedy. The filter itself cannot wear out, and the largest size occupies less than 1 square yard of space. Most important of all, my filter is economical, and its simplicity is such that it may be taken down, cleaned, and put back again into position by ordinary workingmen. The cost of filtering 2,200 pounds of oil varies from 10 cents to 19 cents only. The working of the device is such that virtually no oil remains in the apparatus after an operation, and what does remain is in as good condition as any other unfiltered oil, while older systems of filtration occasion considerable loss of oil, that remaining in the filter being suitable only for mechanical purposes. It is difficult to state the rate of filtration with a given machine, because this rate varies according to the nature of the oil, the amount of impurity in suspension, and its temperature. However, it may be said that when oils are in a normal state—that is to say, have reposed several days after arrival—my filters will treat the following quantities of oil per day of twenty-four hours:

Description.	Quantity.	Price.		Cost of packing.	
	Pounds.	Francs.		Francs.	
No. 2	1,100 to 1,320	750	$144.75	12	$2.31
No. 3	2,200 to 2,750	1,000	193.00	15	2.89
No. 4	4,200 to 5,500	1,500	289.50	35	6.65
No. 5	8,800 to 11,000	2,500	482.50	45	8.68

"We furnish our clients with our own paper, which is manufactured with special care and contains no trace of chemical products. This costs 2 francs (38.6 cents) per kilogramme (2.2 pounds), cut in form for our machines."

The chemical devices to be found in the French olive-oil trade can probably be procured just as well in the United States. They consist of ingenious devices for scouring bottles, for applying corks, labels, and metal capsules, and for filling bottles with great rapidity. One of the best lines of machinery for the treatment of oil and wine is manufactured by G. Pepin aîné et fils, 109 Rue de Notre Dame, Bordeaux.

FIG. 1.—GEODETIC BARRACK DURING OBSERVATIONS AT TULCAN (9,840 FEET ALTITUDE).

THE FRENCH GEODETIC MISSION TO THE EQUATOR.

IN the eighteenth century, the expeditions to Lapland and Peru, due to the initiative of the Academy of Sciences of Paris, solved the problem of the form and dimensions of the globe in favor of the hypothesis of an ellipsoid of revolution flattened at the poles and expanded at the equator. Since then, the numerous measurements of arcs, performed with an incessantly increasing precision, have permitted of further and further narrowing the problem, but the exact solution of it always depends essentially upon the measurement of two arcs of meridian, one in the polar and the other in equatorial regions. The measurements of the eighteenth century, executed by illustrious men, in the labors of whom we shall find much instruction, although they were performed at an epoch at which geodetic science was as yet in its infancy, no longer respond to the modern exigencies of the latter. Their revision was long ago demanded by the International Geodetic Association. Russia and Sweden have, since 1898, been acting in concert in the measurement of an arc of meridian at Spitzberg, and such measurement is in a fair way of completion, notwithstanding all the difficulties inherent to the polar regions. The United States have several times offered to the Geodetic Association to make the measurement of an equatorial arc in South America if France, whose rights of priority they recognized, did not desire to undertake that operation. France could not abdicate her rights. In the wake of the general conference of the association, held at Stuttgart, in 1898, the Minister of Public Instruction sent Captains Mauvain and Lacombe to the republic of Ecuador (upon the territory of which is found the old arc, called that of Peru) with instructions to make a reconnaissance for elongating the arc and preparing the way for the execution of the proposed measurement. These officers staid in Ecuador five months, from July to November, 1899. They traversed the Cordilleras from southern Colombia to northern Peru, and returned with a detailed project carrying the amplitude of the future meridian to 6 deg., instead of the 3 deg. only that the old arc reached, and demonstrating the possibility of the operation.

What reasons have rendered the selection of South America for the measurement of an equatorial arc? There could be no hesitation except between this region and southern Africa. But French Congo, which was thought of for a while, is far from everywhere presenting the safety that is offered to travelers by the regions of South America, which are inhabited by the descendants of the Spanish colonists and by Indians that have submitted to their domination; the climate is more severe, the carriage of material in a country where there are no beasts of burden, as well as the selection of stations in the brush, would have presented insurmountable difficulties. The republic of Ecuador possesses a stable government upon the support of which it was possible to rely. The climate of the high inter-Andean plain, although severe, is not insalubrious. The ways of communication are difficult and almost impracticable in the rainy season, but beasts of burden exist in large numbers and at a low price. Finally, and especially, this country, traversed from north to south by two high parallel chains of mountains, lends itself admirably to the construction of a meridian system of triangles with apices selected alternately upon one and the other of the Cordilleras. After the return of the reconnaissance mission in 1900, M. Poincaré, in the name of the Academy of Sciences, presented a decisive report to the Minister of Public Instruction. Thanks to the initiative of M. Liard and General Bassot, the operation was confided to the Geographic Service of the army, under the supreme scientific control of the Academy of Sciences. This service was naturally designated because of its being provided, since the great work of revision of the meridian of France and of the connection of Algeria with the continent, with all the experienced personnel and all the material necessary for great geodetic enterprises. The mission was not only scientific in character, but also military, and was homogeneous.

Its members were obliged to operate with unanimity, discipline, and economy. At the beginning of December, 1900, the Chambers adopted the project of the law relative to the new measurement of the meridian of Quito, and, for this purpose, voted a credit of 500,000 francs ($100,000). On the 9th of December, 1900, a vanguard, commanded by Captains Maurain and Lallemand, and under orders to complete the reconnaissance of 1899, started for Ecuador.

The main part of the mission landed at Guayaquil on the first of June, bringing with it a large amount of material consisting in great part of the most delicate scientific instruments. The carriage of this to the center of the inter-Andean plain by waterway from Guayaquil to Bababoyo, and then on mule back over the bad road which, near Ganquis, crosses the defile of Chimborazo at an elevation of more than 13,000 feet, required no less than eight successive convoys led by the various officers of the mission, assisted by officers belonging to Ecuador. The box containing the rule of the base apparatus, 14.75 feet in length and weighing 375 pounds, which it was impossible to carry on mule back, had to be intrusted to Indian peons or "guanderos."

The determination of an arc of meridian comprises two series of operations: (1) Geodetic operations, designed to furnish the length of the arc in meters and fractions thereof. A direct measurement is made of the length of a base upon the ground, and of the angles of a chain of triangles established along the arc. From these, by calculation, are deduced the length of all the sides of the triangles, and, finally, the length of the arc. (2) Astronomical operations designed to furnish the amplitude of the arc in degrees, minutes, and seconds. Such amplitude is equal to the difference of the latitudes of the two extreme north and south stations of the arc. It is evident that the length and amplitude of the arc are the necessary and sufficient data for calculating its radius.

Such are the broad lines of the work undertaken in Ecuador; but to such fundamental determinations

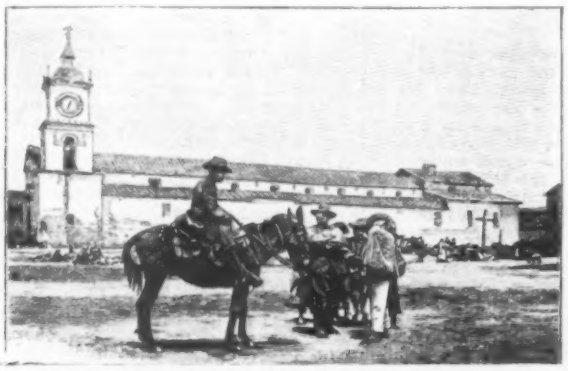


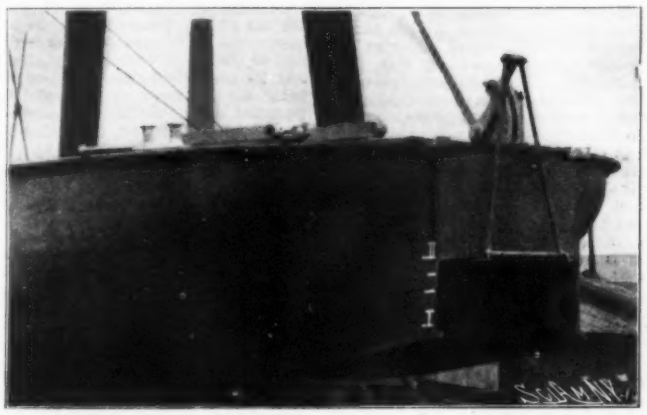
FIG. 2.—AMBATO. CAPT. LALLEMAND AND LIEUT. GIACOMETTI DISCUSSING WITH CABECILLO THE COST OF CARRYING BACK THE BASE APPARATUS.

FIG. 3.—ASTRONOMICAL AND GEODETIC STATION OF LOURA DE QUITO NEAR RIOBAMBA.

(simple in appearance, but of extreme complication in reality) must be added many others just as indispensable. In addition to a central and fundamental base, it is necessary to measure, at the end of the chain, what are called bases of verification. In order that the system of triangles may be placed exactly upon the terrestrial spheroid, it is necessary to determine the orientation or azimuth of a certain number of its sides. A study of the deviations of the vertical necessitates the observation of latitudes and secondary differences of longitudes. In order to ascertain the exact altitude of the stations, a leveling of precision must be effected between one of them and the sea.

The north base of verification of San Gabriel was measured four times, from December 20, 1901, to January 5, 1902, by Captain Lallemand and Lieutenant Perrier, assisted by Dr. Rivet. The land is formed of very wet pasturages, which are often entirely submerged. The rainy season rendered the operations very troublesome, and the work was done almost constantly in heavy rain.

Captain Lallemand, who started February 5 from Tulcan in order to finish the construction of all the signals of the north section of the arc, returned to France in August, after fulfilling his mission at the cost of the greatest difficulties, especially in the desolate region of the counterforts of the Chiles, and at Cotopaxi, to the north of Quito, where he ascended to a height of more than 16,000 feet, in the snow, without finding a favorable point. The determination of the latitudes of the two extreme stations of the arc—a fundamental operation, since it fixes the amplitude of the latter—was effected at the beginning of 1902; for the south station, at Paita (upon the seaboard of Peru), by Captain Maurain; and for the north station, Tulcan, by Lieutenant Perrier. Paita is at 5 deg. 5 min. 8 sec. from the equator, and Tulcan at 0 deg. 48 min. 25 sec. The amplitude of the new meridian is therefore 5 deg. 53 min. 33 sec. Had it been shortened toward the north by the adoption of Tulcan instead of Pasto as an extreme astronomical station, it would have been extended toward the south by the substitution of Paita for Sullana, a station proposed in the project of 1899. The difference of telegraphic longitude between Quito and Tulcan was afterward determined by MM. Maurain and Perrier.



THE STERN OF A SHALLOW-DRAFT SCREW LAUNCH. THE FLAP IS SHOWN AT ITS HIGHEST POSITION SECURING MAXIMUM EFFICIENCY AT 24 INCHES DRAFT.

The work of the mission is completed by determinations of the intensity of the gravity, by magnetic observations, by geological studies, by topographical surveys for the construction of a reconnoitering map of the region traversed, based upon a trigonometrical system of high precision and superior to all the cartographic documents upon the equator that we possess up to the present; and, finally, by anthropological and archæological studies of the indigenous races, and studies of the flora and fauna of the equator.

What are the results obtained up to the present? The measurement of the fundamental base near Riobamba (about 30,830 feet) occupied the mission from July 22 to October 3, 1901. The first measurement of the entire base was made by means of the Brünner apparatus, which had already been used for the measurement of the three bases of Perpignan, Paris, and Cassel. This apparatus comprises numerous accessories and consequently necessitates the employment of a large force of laborers. Forty auxiliary Indians were daily engaged in the carriage of the various parts from front to rear. Extreme fatigue was imposed upon the entire personnel, particularly upon the microscopists (Captain Lacombe and Lieutenant Perrier) by the burning sun, the wind, and the blinding dust raised upon the plain of Riobamba, and necessitated the interruption, at about noon, of the operations begun early in the morning. Nevertheless, a mean progress of 1,180 feet was made every day. A segment of 11,000 feet was measured a second time by way of verification. The two measurements recently calculated varied only by 1-450,000. The base was afterward measured twice by means of the Jäderin apparatus, which is simpler, less cumbersome, and much more practical than the Brünner, and which, properly employed, furnishes a remarkable precision.

In the meanwhile, Captain Maurain had recognized all the signals from the chain in the vicinity of Riobamba, and determined the latitude of the Panecillo station, near Quito. The sojourn of the rest of the mission at Riobamba was utilized for the determination of the latitude of Riobamba, of the telegraphic difference of the Riobamba-Quito longitude, and of the intensity of gravity at Riobamba.

In October-November, 1901, the mission divided up into detachments for operating isolatedly. Commandant Bourgeois, whose function as chief of the geodetic section called him back to Paris temporarily, arrested, before his departure, the programme of the work for 1902, this year having, in principle, to be devoted to the finishing of the section of the arc situated to the north of Riobamba. The project of 1899 anticipated the extension of the arc to the north as far as Pasto, in Colombia. The north astronomic station was to be established near Pasto, and the north base to be measured in the vicinity of Cumal. But at the end of 1901, Colombia was the theater of serious troubles, and the French representative at Bogota advised that the territory of Colombia should not be entered. It therefore became necessary to shorten the projected arc a little to the north, and seek a new astronomical station and new base in Ecuador. Captain Lallemand, who was sent on a reconnaissance to Carchi at the beginning of November, 1901, constructed a temporary observatory near Tulcan, a small frontier town situated in an amphitheater formed by the valleys of the affluents of the Carchi River which converge toward Ipiales, the scene of frequent battles between the liberal Ecuadorians and conservative Colombians. At the same time, in this elevated region, where the two Cordilleras become confounded to form the *massif* or difficult passage of the *paramo* of Angel and of the Altos of Boliche, he recognized the impossibility of finding a site favorable for the measurement of a base elsewhere than upon the plain of San Gabriel de Tusa. Commandant Bourgeois proceeded to Tulcan in order to verify these facts. A movement toward the north was effected by four convoys in November and December. The head of the mission, after a definite settlement of the question, set out from San Gabriel for Quito, and returned to France in February. After his departure, the mission was placed, in Ecuador, in charge of Captain Maurain.

At present the mission is distributed into three detachments in charge of the geodetic observations, from Tulcan to Riobamba, the one to the north, the other to the south, and the third in the center. At the north, Lieutenant Perrier, accompanied by Dr. Rivet, occupied the stations of Troya and Mirador. At Mirador, an imposing *massif* which dominates the plain of St. Vincento, the loaded beasts were unable to ascend, and the material was carried up by Indians over a footpath formed through the virgin forest that covers the sides of the mountains. A secondary latitude will be determined before long at Pinllar, near Ibarra. An observation detachment of the south, operating since November, 1901, under the orders of Captain Lacombe, has now finished the operations around Riobamba and transferred its center of operations to Ambato. Finally, at the center, Capt. Maurain, in conjunction with M. Gonnessiat, French director of the observatory of Quito, determined the difference of longitude between the observatory and Panecillo, a station of the system, so as to make the observatory the central point for all observations of longitude. After this, he finished the construction of the signals between Riobamba and Quito, determined a secondary longitude at Latacunga and began his geodetic campaign with the station of Pambamarca, a point of the old meridian still named Frances-Urcu ("Summit of the French") in the country. Many difficulties interfered with the operations, some of which were due to the climate. The rainy season put the patience of the observers to a severe test, and it required an entire month to obtain at Tulcan a latitude that in fine weather could have been obtained in eight days; and six weeks at Mirador, in constant fogs, clouds, and rain, to make observations that could have been effected in a few days in France. Other retardations were due to the numerous destructions of signals by fanatic Indians who were instigated by their superstitions. To the north of Quito, it became necessary to re-establish those of Troya and Mirador, and, to the south, those of Chujaj, Mulmal, Lalanguso, and Pambamarca. The effective and enlightened aid of General Plaza, President of the republic, never failed the mission under any circumstances, and his government, which several times contributed pecuniarily to the work, took energetic measures to prevent any further destruction; but such acts remain always to be feared, despite the readiness of the local authorities, who are often powerless to reach the guilty.

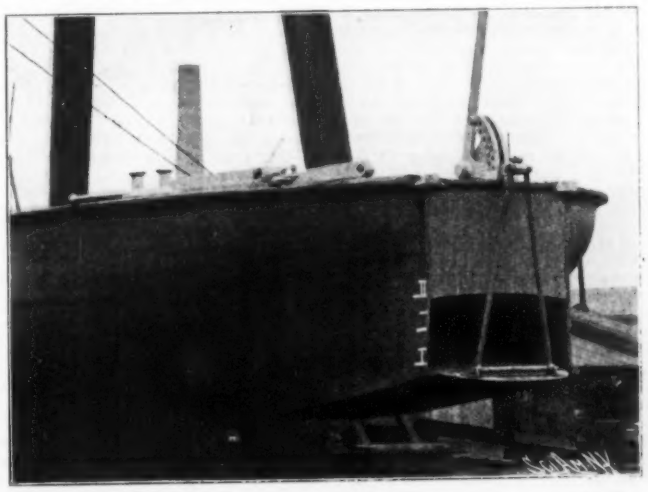
On the whole, a considerable amount of work has been accomplished. Everything leads to the hope that the Tulcan-Riobamba operations will be finished in 1903 and that, in the same year, the activity of the mission will be seen in the Riobamba-Cuenca section. The beginnings have necessarily been difficult. At present, the personnel is in a manner inured, broken in, and habituated to the country, and will bring the work to a successful conclusion. To aid it, it has two powerful auxiliaries—M. de Sainte-Marie, chancellor of the legation of France at Quito, and M. Gonnessiat, director of the Quito observatory.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

IMPROVED DESIGN OF SCREW PROPULSION FOR SHALLOW-DRAFT BOATS.

A NEW and ingenious departure in the design of shallow-draft boats for service upon rivers, where the depth of water precludes the utilization of the conventional type of vessel, has been designed by MR. A. F. Yarrow, of London, who has made a specialty of this type of craft. We have from time to time described and illustrated in the columns of the SCIENTIFIC AMERICAN the shallow-draft boat of the Yarrow design, wherein the propellers revolve in a small tunnel.

The principle of placing the screws in tunnels is by no means recent. In 1856 John Buchanan patented a plan of this type, in which the propeller revolved in an arched tunnel built up from the base of the hull. In Buchanan's idea, when viewed from a cross section, the tunnel has perfectly straight sides, with the top of semicircular form. But Buchanan's invention did not have a very successful vogue, and his principle was not adopted upon any large scale for several years. In 1875, however, the firm of Thornycroft's, of Chiswick on Thames, who also make a specialty of the construction of shallow-draft boats, built a vessel somewhat upon the lines advocated by Buchanan for service on the river Nile. It was a large launch, 63 feet in length by 8 feet 6 inches beam, and 2 feet 6 inches draft. This boat was provided with twin screws, and developed a speed of 9 miles per hour. The propellers were of 3 feet diameter—6 inches more than the draft of the vessel. Further boats were built upon the same lines, but the results of prolonged experiments which were carried out demonstrated that no advantages accrued by this arrangement over the general system of placing the propellers outside the boat in the usual position astern. In fact, two boats, built by Messrs. Denny, of Dumbarton, which had the propellers placed in the tunnel, required such a high velocity of the engines—400 revolutions per minute—that the natives were frightened. Thereupon two propellers in tandem were fitted to the shaft, and equally good results were obtained with the engine making less revolutions.

During late years Mr. Yarrow, however, has successfully surmounted the inherent defects of the present system of placing the propellers in tunnels. In his general type the upper part of the tunnel is placed considerably above the water line, so that the diameter of the screw may be greater than the draft of the vessel. His basis of construction is broadly to fit a boat drawing 12 inches of water with a propeller 2 feet in diameter; a boat drawing 2 feet of water with a screw 4½ or 5 feet in diameter, and so on. When the vessel is stationary, the level of the water inside the tunnel is precisely the same as that of the water outside, but directly the screws commence revolving the air present in the upper part of the tunnel is driven out and replaced by water. By this arrangement a propeller of great power, owing to its continually working in solid water, can be employed in combination with a



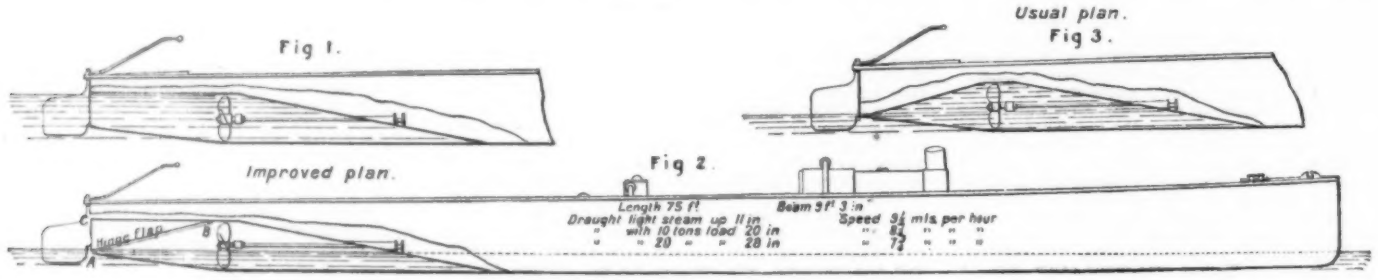
SHALLOW-DRAFT LAUNCH WITH FLAP DOWN CORRESPONDING TO 11 INCHES DRAFT.

shallow draft. In this system the resistance to the forward progress of the vessel is greater, owing to the propeller having to combat a greater pressure of water in the inclined portion of the tunnel forward of the propeller; and although this resistance is encountered with all types of screw vessels, it is proportionally greater in this class of vessel. Furthermore, owing to the resistance of the inclined surface of the tunnel aft of the propeller, which it may be mentioned is placed at the point of the tunnel where the diameter is the maximum, there is a loss of efficiency. But by making the aft portion of the tunnel as horizontal as possible, this resistance may be obviated, though this arrangement increases the length of the tunnel, and involves greater draft, since the augmentation of the capacity of the tunnel below the water line is just so much displacement, and the water in the tunnel is equivalent to the bulk of load carried when the boat is at rest and the tunnel full. It will therefore be recognized that it is essential that the capacity of the tunnel should be reduced to the minimum, owing to the fact that the question of draft does not always render it practicable to select a favorable inclination at the after part of the tunnel without involving losses already mentioned.

Mr. Yarrow, however, has now perfected a device by which the efficiency of the shallow-draft boat may be improved, especially for towing purposes, in which respect it has been stated that vessels built upon the foregoing plans were not so satisfactory as vessels fitted with the propellers in the usual manner, or the stern-wheelers. This device comprises an arrangement by which the upper part of the tunnel aft of the propeller to the stern in hinged in such a manner that it can be raised or lowered to any desired height. This operation can be performed either automatically or by mechanical effort. In these types of vessels it is imperative that the air should be prevented from entering the tunnel from the rear, otherwise the screw does not work in solid water. In starting, the after part of the tunnel must be below the water line, say from 2 inches to 3 inches, so as to avoid any possibility of the air entering the tunnel; but directly the boat is well under way, the outlet of the tunnel may be raised several inches above the water line, since the volume of water rushing out in an opposite direction to that which the boat is traveling renders it impossible for any air to gain access to the interior of the tunnel. Furthermore, if the after part of the tunnel is brought above the level of the outside water, greater efficiency is obtained, as there is less resistance to the inclined surface aft of the propeller. At the same time, however, if the after part of the tunnel is fixed when traveling at full speed, it will be unnecessarily low down, and act somewhat as a drag upon the vessel.

Tug.	I. H. P. of engines.	Pull on tow rope.	Horse power at rope.	Percentage of power of machinery utilized in towing.	Speed per hour.
Screw tug.....	118.24	2,001 lb.	44.1	37.3	5.70
	94.67	2,321 "	32.3	34.2	5.32
	61.97	1,823 "	21.3	34.4	4.38
Side-paddle tug..	90.02	2,314 "	31.6	35.0	5.12
	49.98	1,714 "	20.0	40.0	4.31

It will therefore be realized from these trials that the proportion of the power used in the towing is approximately the same in both instances. At the same time, however, the paddle tugboat proved superior at the low speeds, while the advantage rested with the screw boat at the high speeds. These tests conclusively prove that the towing efficiency of a boat equipped with the Yarrow tunnel method of propulsion is in every way adapted to such work, and a boat of this description is almost as efficient as a vessel fitted with the screws in the orthodox manner, the advantage of the latter being too insignificant to warrant its adoption. Another distinct recommendation in favor of the tunnel type of boat is its lower initial cost, while the craft is in every way as efficient at light draft as at heavy draft, which is not the case with the paddle tugboat, as in the majority of cases if the latter is good at a light draft it is bad at a heavy draft, and *vice versa*.



YARROW SHALLOW-DRAFT LAUNCH.

It is to overcome this disadvantage that the method of adjusting the after part of the tunnel has been devised. One of our photographs shows the flap lowered for a draft of 11 inches; another photograph shows the flap at its highest position, securing maximum efficiency at 24 inches draft. A comprehensive idea of the extent to which the efficiency of the vessel may be augmented may be gathered from the fact that in the case of a launch when light, of 11 inches draft traveling at 9.2 miles per hour with the flap down, the speed is increased to 10 miles per hour when the flap is raised; and when the draft is 28 inches loaded with 20 tons, the speed is increased from 6.9 miles per hour with the flap down to 8.25 miles per hour with the flap up, without any increase of the power. The increased efficiency of the craft is greater when loaded with the flap up than when light, but the low speeds are what they would have been without the adjustable flap, which clearly demonstrates the advantage of the acquisition.

A series of practical experiments have been carried out by the inventor to demonstrate this increased efficiency, and also to prove at the same time the towing capacity of boats propelled in this manner, as compared with vessels equipped with the conventional propelling systems. A twin screw tug was built for the Trent Navigation Company upon these lines, the dimensions of the craft being length 80 feet, beam 14 feet 6 inches, and draft with steam up 22 inches. The displacement was approximately 40 tons. These dimensions and draft were determined by the size of the locks upon, and the depth of, the river. For the purposes of comparison, a side-paddle tug generally used by the Navigation Company for towing barges on the lower and deeper part of the river, where there are no locks, was used. This latter craft measured 91 feet 6 inches in length by 14 feet beam, breadth over paddle boxes 24 feet, draft 3 feet, displacement about 55 tons. The paddle boat was driven by two cylinders of 18 inches diameter by 27 inches stroke, steam being supplied by a return-tube marine boiler, while in the screw boat a single inverted engine 10 inches in diameter by 10 inches stroke drove each screw, steam being supplied from a locomotive boiler.

In order to obtain comparative efficiencies under ordinary working conditions, five barges representing a total load of 247 tons were towed first by one tug and then by the other over the same part of the river, the engines being indicated at different speeds. The pull on the rope was ascertained by means of a dynamometer. The results obtained were as follows:

THE TREATMENT OF DISEASE BY ULTRA-VIOLET RAYS.*

By WILLIAM J. HAMMER.

SOME professional matters detained me in Copenhagen last summer for several weeks, and during my stay in that city I had the privilege of visiting the Finsen Light Institute at Rosenvaengat, a suburb of Copenhagen, and was enabled to investigate the system for the treatment of disease by light, inaugurated by Dr. Niels R. Finsen.

Dr. Finsen has conducted very extensive and most painstaking researches into the bactericidal effects of light, and he has found both ends of the spectrum to possess remarkable curative powers.

The red rays have been used most successfully in the treatment of smallpox, and for the removal of such disfigurements as birthmarks, moles, etc.; and he has also found that by utilizing the blue, violet and ultra-violet rays at the other end of the spectrum, those loathsome diseases tuberculosis of the skin and lupus, diseases which have baffled surgical skill heretofore, have been successfully combated.

It has recently been stated that in New York city alone there are annually 20,000 cases of tuberculosis, with 8,000 deaths; and there is probably no disease with which mankind is afflicted which compares in deadly character to tuberculosis.

In affecting certain of the internal organs, it is known as consumption, and appearing externally, attacking the skin and underlying tissues, it is known as lupus vulgaris. As a rule, it appears in single patches, most frequently attacking the face, especially the nose, cheek, and mouth. It may, however, attack the extremities or, in fact, any portion of the body and even mucous membranes. Fortunately, lupus is rather rare in this country, although very common in Europe.

Koch and others have fully demonstrated that tuberculosis is due to the presence of specific organisms named "tubercle bacilli," which have been found to be present in both the internal and cutaneous forms of the disease.

Doubtless many present remember the "blue glass craze," which swept over the country in 1876, or thereabout.

I have with me here a copy of Gen. A. J. Pleasonton's book entitled, "Blue and Sun Lights. Their Influence upon Life and Disease," which I picked up in a second-hand book store some years ago; and I would commend the examination of this book to all who are interested in the subject. Gen. Pleasonton and his system were condemned to both abuse and ridicule. Dr. Finsen, however, says, "The general was absolutely on the right track."

For a considerable time Finsen's work received little credence and no encouragement; but he persisted in his investigations, and the results secured by him finally bore fruit, and to-day the world rings with his praises. In all parts of the civilized world his work is being taken up, and institutes are being founded for the treatment of disease by light rays—particularly the ultra-violet light. In England the initiative was taken by Queen Alexandra, and in Russia by her sister, the Czarina, they both investigating the system while visiting their father, the King of Denmark. Much has also already been done in the United States. As an evidence of the importance attached to his work, I would call attention to the fact that Prof. Finsen has recently received the "Nobel" prize of $50,000, as a reward for his contributions to surgery and medicine.

It will be remembered that during Queen Elizabeth's reign a certain court physician recommended strongly that patients suffering from smallpox should be kept in a room, the decorations of which, including the hangings, bed draperies, etc., should be red in color, claiming that the red light had a soothing effect upon the irritated portions of the skin, lessening the severity of the disease. Little importance was attached to this method, and the originator of it was branded as a charlatan.

Prof. Finsen, has, however, found that this method of treatment of smallpox is of paramount importance. He has placed patients in a room into which the sun's rays could only penetrate through sheets of red glass, just as they would penetrate a photographic dark room; and he has found that patients placed in such a room prior to the most painful and most dangerous suppuration stage setting in, suppuration has been entirely prevented and that the scarring has been in nearly all cases absolutely prevented, and in the few cases where there was any scarring, it was hardly perceptible. The disease has been in a much milder form, the fever usually accompanying the eruption disappearing, and the temperature remaining normal.

He has found that the use of ultra-violet light on these patients very much aggravated the disease, and even in cases where patients were almost cured and they have been allowed to go out into the sunlight, the disease has at once been aggravated.

In connection with his investigations into the effects of light Finsen made some interesting and ingenious experiments upon earth-worms placed in a box, one-half of which was covered with red glass and the other half blue glass; and he found the blue light irritated the worms so they invariably crawled under the red glass, and a chameleon, placed with its body midway between the glasses, turned almost jet black under the influence of the blue rays, while that portion under the red glass remained nearly white, which Prof. Finsen says showed that the chameleon was altering its pigment cells to lessen the irritating effects of the blue light.

The ultra-violet end of the spectrum contains the most refrangible rays, and it is these rays which are so harmful in cases of smallpox; and it is also these actinic rays which produce sunburning, which one often experiences in the Alps, or any high altitude where the temperature may be considerably below zero; and there are doubtless many present who have experienced considerable effect similar to sunburning by working in close proximity to arc lamps.

While these ultra-violet rays are so harmful in the case of smallpox, they are of the precise nature which is most desirable in the treatment of such diseases as tuberculosis of the skin or lupus vulgaris. These rays not only destroy the bacilli, but they excite and stimulate nutrition and excite activity in granulation, thus assisting very greatly in the rapid recovery from the disease.

Doubtless the rays emanating from the sun are very rich in blue, violet, and ultra-violet light; but the atmosphere readily absorbs these rays, and while Prof. Finsen for a time used the sun's rays in the treatment of tuberculosis of the skin and lupus he found that by employing the arc light the same effect could be produced in a very much shorter space of time; and that he was in this way, also, independent of weather conditions.

The arc light is much richer in ultra-violet rays than the sunlight; and Broca and Chatin of Paris have found that by placing an iron core inside of the positive carbon electrode, this arc was still richer in ultra-violet light, and Görl, of Erlangen, has constructed a form of aluminium arc, in which four arcs were formed between five aluminium electrodes. I have here a modification of Görl's lamps constructed by Messrs. Waite & Bartlett of this city, in which there are four iron electrodes forming three iron arcs in series, which produce an intense source of ultra-violet light, which I shall presently show in operation.

Bang and others have also made arc lamps employing terminals of iron.

It is claimed that by employing the iron arc the same results which take an hour and ten minutes by means of the carbon arc can be accomplished in twenty minutes to half an hour; and also that so intense are these ultra-violet rays it is not necessary to use pressure to drive the blood away from the diseased part, and it is also unnecessary to use water to cool the rays.

Drs. Piffard and Jamieson have suggested the use of suprarenal extract in the form of adrenalin chloride, which the former prefers to introduce into the skin around the diseased spot by cataphoresis, thus producing a whitened area from which the blood has been withdrawn, which enables the treatment of this portion by the ultra-violet light, without pressure being applied, and the blood does not return for half an hour or more. The cataphoric electrode is covered with a thickness of lentine saturated with adrenalin connected with a positive pole of the battery, using a current of from three to four milli-amperes, the bleaching taking from four to five minutes' time.

* Abstract of a lecture delivered before the joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, New York, April 17, 1903.

The Roentgen rays have been found very effective in the treatment of certain diseases, especially where hard tubes are employed.

The original blue lens used by Finsen when employing sunlight, consists of a flask full of light blue ammoniacal sulphate of copper. The bottle with its contents makes a plano-convex lens. The sunlight passing through this is found to work very well; but it was too slow, and the sun was frequently obscured. Finsen later used plain water, finding that the blue water cut off most of the ultra-violet rays and he found the clear water very largely absorbed the red and ultra-red rays which caused the heat.

The diagrams show a form of telescope which is now adopted in standard practice at the Finsen Institute. It contains four rock crystal lenses, which act to cut off considerable of the heat rays, but allow the ultra-violet light to pass through.

It will be remembered that ordinary glass cuts off almost all of the ultra-violet rays whereas a block of rock crystal 4.4 mm. thick will allow 60 per cent of the ultra-violet to pass through it.

A part of the heat is also absorbed by the distilled water which is contained inside of the telescope. In order to keep this water cool, there is an outside jacket on the telescope, through which circulating water may be passed for this purpose.

Blood is opaque to ultra-violet light, and it is therefore necessary to drive the blood away from the diseased portion which is to be treated. This is accomplished by what is known as a pressure glass. It consists of a plano-convex lens of rock crystal kept cool by circulating water—the glass acting to focus the light on the diseased portion, and also to exert considerable pressure there.

FINSEN TELESCOPE TUBE, FOR USE WITH CARBON ARC LIGHT.

The patient does not suffer from exposure to the rays; but after the treatment, which is usually an hour and ten minutes per day, he appears to be considerably sunburned. He is then allowed to recuperate until the next day, and the treatment is then repeated. After a series of these treatments, the patient is sent away apparently cured. Sometimes he does not return; but more often he must come back for a second or third, and even more series of treatments, due to the fact that certain of the microbes which have been deep-seated have worked their way to the surface, the disease having started anew.

It is said that out of over 600 cases treated at Copenhagen, there have been practically no failures due to fault in the treatment; but there have been cases where the disease has been in such an advanced stage and for such a very long period that it has not yielded successfully. But I was informed that in the majority of cases after very few treatments, the patients are dismissed absolutely cured. In order that you may properly appreciate the remarkable results which have been secured by Prof. Finsen, those caring to look up these and similar cases will find full descriptions in English in "Phototherapy after Finsen's Methods," by Valdemar Bie, M.D., Prof. Finsen's Assistant (published by Lippincott), or Die Bekämpfung des Lupus Vulgaris von Niels R. Finsen (Fr. Bogges Buchdruckerei, Kopenhagen), and Die Finsen Therapie und ihr gegenwärtigen stand in der Dermatologie, von Dr. Forchhammer I. Cohen's Buchdruckereien Kopenhagen).

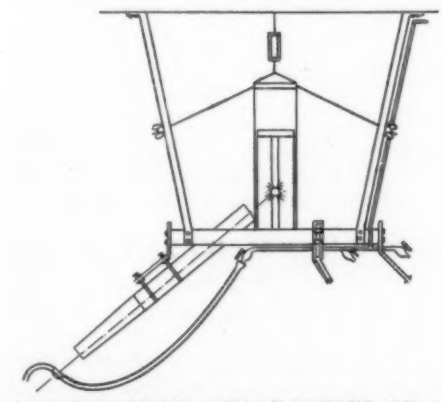


DIAGRAM SHOWING ARRANGEMENT OF ARC LAMP AND FINSEN TUBES.

The Finsen Institute was established in 1896, through the munificence of Copenhagen's public-spirited citizens, and through a gift by the city of the property on which it was erected.

NEW FORMS OF RADIATION.—L. Graetz describes some new "radiation" phenomena which are of a strange and puzzling nature. It is known that hydrogen peroxide produces an "emanation" which affects photographic plates through ebonite, gutta-percha, chloroform, petroleum, and other bodies. The author places a photographic plate over a vessel containing H_2O_2, with the film side down. It is, of course, blackened. But if a metallic cross is laid on the glass side it impedes the blackening, and the cross is dimly traced through the glass on to the film. The effect is increased by interposing blotting paper soaked in petroleum between the cross and the glass, and still more by soaking the paper in water, alcohol, or, especially, ammonia. All these increase the blackening, and let the cross appear brighter in comparison. The cross is always brightest at the margins. Non-metallic bodies show no action by themselves, but they are traced through faintly when soaked blotting paper is interposed. Whenever the metal is chemically affected by the moisture it appears peculiarly bright, and thus we have a new indicator of chemical action. Temperature also has a great influence, and the author hopes to apply this fact to infra-red spectroscopy. Electric charges do not influence the phenomenon. The paramount influence of temperature suggests an explanation based upon thermal conduction.—L. Graetz, Physikal. Zeitschr., December 1, 1902.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

United States Machinery in France.—The United States holds the lead in competing with foreign and domestic manufacturers of machinery here. By this I do not mean to say that American exporters have secured all the trade possible for them to obtain in this district; on the contrary, much more remains to be gained than has already been won. This may be best accomplished by studying the local needs, habits, prejudices, and even caprices which I shall mention in detail in this report.

The greatest drawback to the development of our trade in machinery in Europe is due to the effort of American exporters to induce these people to purchase engines which are not fitted to their needs or to which they are wholly unaccustomed. This does not imply that no new or improved invention should be put upon the French market; but in introducing these it is necessary to clearly demonstrate their utility.

Agricultural Machinery.—American thrashers, reapers, binders, and mowers have a monopoly of this trade, and they are becoming more popular each year. French plows are universally employed, the ground to be worked being of such a nature that the plowman's share of the labor is comparatively light. English horserakes continue to crowd out the American implement. This is due to the fact that the French farmers do not like the wire tines on the American machine. Frenchmen are not wholly pleased with the English machine—it is too heavy and cumbersome. This is a trade worth securing, and American manufacturers can win it by substituting the cast-steel tine for the one generally used at home.

Bicycles.—Three years ago all high-grade wheels sold in this section were of American manufacture, with but two exceptions. At that time the outlook was very favorable, but now all is changed. This is due probably to two things: First, the combine of dealers in American wheels in France has shut out competition of the various makes and has maintained prices that are entirely disproportionate to the cost of the same wheels in the United States and, in almost every case, much dearer than the best wheels of French make; second, because the agents lack that generosity and frankness in business which encourages the sale of wheels. I can cite instances where purchasers, at La Rochelle, of one of our best-known bicycles had so much trouble in having certain defects remedied that it was only after weeks of correspondence and complaint, and shipments of wheels to Paris several times, that they were able to enjoy a spin on their American machines. Two instances in particular, in which the purchasers were officials of high rank, practically destroyed our trade at La Rochelle. The choice of an agent for France is all important in this business, and he should not be of the "few sales, big profits" kind. An American machine which sells for $50 at home should sell for less than $90 in France.

Steam Engines and Boilers.—American manufacturers, to judge from prices submitted in several instances, are able to sell stationary engines and boilers here at from 30 to 35 per cent below the prices asked for French machinery of the same nature; this includes transport and duty, but no local commissions. Slight changes in valves and other parts might enhance the value of engines of this kind, once they are locally known.

Fire Engines.—There are scores of towns in southwestern France of more than 6,000 inhabitants which have totally inadequate fire-fighting appliances. Most of them have inefficient hand pumps; and while large fires are not frequent, yet they are important enough fo create a need for steam pumps. An enterprising American firm would probably take many orders by exhibiting from town to town an automobile steam fire engine of moderate price. As the cities are near together the experiment should not be costly. Many thousands of these people have never seen such an engine at work and are consequently unable to judge of its real worth as a fire fighter.

Locomotives.—The first experiment with American railway engines began in 1900, when the administration of the State Railway Company put twenty Baldwin machines into operation. Long before it was possible to arrive at any definite judgment regarding the utility and economy of these engines on French roads all kinds of unfavorable criticism appeared in various French journals, some ridiculing their lofty structure, others imagining what would happen if they left the rails, and still others claiming that, in spite of their low first cost, they were not economical, as the boilers lost much steam and were continually in the repair shop. The director of the State Railway Company, in answer to my inquiry, said that these engines have been giving satisfactory results, and go no oftener to the repair shop than do other machines.

I called upon the officials of three French railway companies and they agreed that they had found the American locomotives satisfactory and as economical—when given all the work they could do—as their French engines. On one thing, however, they all insisted, i. e., that American manufacturers should fashion their products so as to conform to the requirements of the French law.

Almost without exception, changes were made in the American locomotives in order that the various parts might stand in the relation required by French law. In some cases, a redistribution of weight on the rails was necessary, and in several instances the grates were not fitted to burn the coal in use upon that particular railway system. These and the other changes made after their arrival in France could be obviated by study on the part of the manufacturer. Any article loses in prestige when a modification is found necessary in the country to which it is exported.—George H. Jackson, Consul at La Rochelle.

Coal Industry in British Columbia.—The Vancouver Island mines are better developed than ever in the history of the Province of British Columbia. During 1902 coal was mined to a larger extent than ever before, notwithstanding the competition with the fuel oil of California. Some 1,731,000 tons of coal were mined in the Province during 1902, and about 200,000 tons of that amount were converted into coke, making 127,800 tons of this latter product.

There has been an important discovery of anthracite coal 4 miles from Cumberland, near the celebrated Comox mines. The deposit is found to be extensive, the same vein cropping out in places 2 or 3 miles apart. None has been brought to market, but 60 men are employed in developing it and a railway is in process of construction thereto. The anthracite is of excellent quality, shows an analysis of 80.7 in carbon, and is practically smokeless. The Wellington Colliery Company, which owns the ground, expects to have the coal on the market by next fall.

The Extension mines, 10 miles south of Nanaimo, owned by the Wellington Colliery Company, have been closed since the middle of March. The cause is not any question of wages. In March a meeting of the employes was held to consider the question of asking for increased wages, when, at the instance of a representative of the Western Federation of Miners (an organization which has its headquarters in California), a large majority of the men present voted to form a union and to make it a branch of the Western Federation. As soon as the news of this action reached Mr. James Dunsmuir, the president of the Wellington Colliery Company, he directed that a notice be placed all through the vicinity that the mine would be closed April 1, 1903. The men responded on March 10 by voting to quit work at once. Since then not a ton of coal has been produced in this great mine. The men insist on their right to join any union they choose, and the directors of the Wellington Colliery Company maintain that while they have no objection to the men forming a union among themselves, they will not employ men who belong to an international organization and are subject to the orders of men living outside of Canada. The result is that 1,000 miners have been idle for six weeks, and the town of Ladysmith is rapidly becoming depopulated. Large numbers of the miners have left the island and have obtained work in the Crow's Nest, or Washington, mines. The president of the colliery company, in a published interview, insists that he has spent millions of dollars in the development of his mines and will not submit to any interference by outside labor organizations, but will rather close his mines for ten years.

Up to date, therefore, the expected extension of coal export to San Francisco, owing to the suspension of the United States duty on coal, has been effectually checked. Indeed, a coal famine in this city has been prevented only by the importation of coal from Washington, and the price has been raised from $6 to $6.50 per ton for household use.

The acuteness of the situation here has been brought to the notice of the Dominion authorities at Ottawa, and a labor commission appointed to investigate the same. It will next month commence to receive evidence in Victoria and other points in the Province, but there is no promise of either side agreeing to accept the findings.—Abraham E. Smith, Consul at Victoria.

American Coal in Western France.—I would call the attention of our coal-exporting firms to the fact that no American coal has reached this market for more than a year. It seems that those who have heretofore thought of Nantes as a permanent market for our coal no longer regard it favorably. The fact is that the few efforts that have been made to gain a foothold for American coal in this part of France have not been made intelligently. A good market for American coal can be found here, if the proper methods are pursued at the outset. If any of our coal exporters are interested in entering this field, I would be glad to furnish them with certain facts and practical suggestions which, if considered and followed, would open the market to them. The French and English miners at present controlling the market have entered into a trust for mutual protection, and have recently advanced prices about 20 per cent.—Benj. H. Ridgely, Consul at Nantes.

German Request for Slag.—Consul J. White reports from Hanover, April 14, 1903, that Herr Ernst Hurtzig, of No. 17 Joseph Strasse, Hanover, desires quotations on Thomas slag, to be delivered f. o. b. Hamburg or Bremen, Germany.

Request for Names of Whale-Oil Dealers.—Consul-General W. R. Bigham writes from Cape Town, April 6, 1903, that a whaling firm which wishes to sell from 4,000 to 8,000 gallons of whale oil per annum desires to get the addresses of parties in the United States who deal in this oil.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1649. May 18.—Tar-macadam Roadways in Ontario.

No. 1650. May 19.—Mineral and Agricultural Resources of Peru—Commerce of Uruguay for 1902—Railroad through Galilee.

No. 1651. May 20.—The Manufacture and Use of Cranes in Germany—New Railways in Southeast Africa—Maltese Lace.

No. 1652. May 21.—Agricultural Products of Nicaragua—Kerosene Pipe Line in Roumania—Silk Muslin Manufacture—*American Pork in Turkey.

No. 1653. May 22.—British House-cleaning Device—New Machine for Manufacturing Ice in Germany—*Windmills in Siam—Import Duties in Colombia—Grapevines in Hungary—*Bicycles in China—*German Request for Slag.

No. 1654. May 23.—The Relation of Iron Consumption to National Prosperity—Commercial Treaties in Europe—Iron vs. Steel in British Shipbuilding—Wine Trade of Cuba—Request for names of Whale-oil Dealers.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECIPES.

Process for the Manufacture of Carbon Tetrachloride.—The following are examples of the working of this process:

First Example.—In a vertical retort of fireproof material unattackable by chlorine, similar to those employed for the manufacture of carbon sulphide, or for the distillation of the sulphide, heated on the outside and previously charged with charcoal, coke, etc., any chloride of sulphur is introduced at the lower part by means of a suitable arrangement; the products formed are condensed by refrigeration and consist of carbon chloride and carbon sulphide with sulphur chloride, the latter being probably induced mechanically.

By distillation, the three products are separated. The carbon sulphide may be converted by ordinary processes into carbon tetrachloride and sulphur chloride, and the latter joined to the sulphur chloride already recovered, may be returned to the manufacture.

Second Example.—In order to avoid the elutriation of the carbon sulphide, and for the immediate conversion into carbon tetrachloride of all the carbon contained in the sulphur or the carbon sulphide, it is sufficient to attach to the apparatus previously described an inlet for the chlorine in the lower part.

Under these conditions, on suitably regulating the introduction of the chlorine, the liquids condensed at the exit of the retort, are much richer in carbon tetrachloride.

If a dephlegmator is arranged at the exit of the retort, and the temperature suitably regulated, almost all the sulphur chloride produced is condensed in the dephlegmator and may be siphoned back to the lower part of the retort, while the vapors of the carbon tetrachloride are collected as previously by means of a refrigerant. The liquid thus condensed, now contains but a slight proportion of carbon sulphide.

Under these conditions, the continuous manufacture of carbon tetrachloride is secured without sub-products by introducing into the apparatus, when it has been set at work, only charcoal and chlorine, the sulphur chloride serving only as an agent for conversion and constantly remaining in the apparatus or its attachments (dephlegmator, siphon, etc.).—From the French, in La Revue des Produits Chimiques.

An Acid-Proof Table Top.—Three or four years ago the writer saw in a pharmaceutical journal (Merck's Report) a formula for a black finish for table tops. The article did not give the author's name nor the original source of the formula, but stated that the method was "used abroad." Further acknowledgment cannot, therefore, be made. The formula was as follows:

1.

Copper sulphate	1 part
Potassium chlorate	1 part
Water	8 parts

Boil until salts are dissolved.

2.

Aniline hydrochlorate	3 parts
Water	20 parts

Or, if more readily procurable:

Aniline	6 parts
Hydrochloric acid	9 parts
Water	50 parts

By the use of a brush two coats of solution No. 1 are applied while hot; the second coat as soon as the first is dry. Then two coats of solution No. 2, and the wood allowed to dry thoroughly. Later, a coat of raw linseed oil is to be applied, using a cloth instead of a brush, in order to get a thinner coat of the oil.

The writer used this method upon some old laboratory tables which had been finished in the usual way, the wood having been filled, oiled, and varnished. After scraping off the varnish down to the wood, the solutions were applied, and the result was very satisfactory.

After some experimentation the formula was modified without materially affecting the cost, and apparently increasing the resistance of the wood to the action of strong acids and alkalies. The modified formula follows:

1.

Iron sulphate	4 parts
Copper sulphate	4 parts
Potassium permanganate	8 parts
Water, q.s.	100 parts

2.

Aniline	12 parts
Hydrochloric acid	18 parts
Water, q.s.	100 parts

or—

Aniline hydrochlorate	15 parts
Water, q.s.	100 parts

Solution 2 has not been changed, except to arrange the parts per hundred.

The method of application is the same, except that after solution No. 1 has dried, the excess of the solution which has dried upon the surface of the wood is thoroughly rubbed off before the application of solution No. 2. The black color does not appear at once, but usually requires a few hours before becoming ebony-black. The linseed oil may be diluted with turpentine without disadvantage, and after a few applications the surface will take on a dull and not displeasing polish. The table tops are easily cleaned by washing with water or suds after a course of work is completed and the application of another coat of oil puts them in excellent order for another course of work. Strong acids or alkalies when spilled, if soon wiped off, have scarcely a perceptible effect.

A slate or tile top is expensive not only in its original cost, but also as a destroyer of glassware. Wood tops when painted, oiled, or paraffined have objectionable features, the latter especially in warm weather. Old table tops after the paint or oil is scraped off down to the wood take the above finish nearly as well as the new wood.—Pierre A. Fish, in the Journal of Applied Microscopy.

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TABLE OF CONTENTS.

PAGE

I. AGRICULTURE.—The Treatment of Olive Oil in France..... 22905

II. ARCHÆOLOGY.—Discovery of Remains of Bermondsey Abbey. 22900
Restorations and "Fakes."—6 illustrations..... 22902

III. AUTOMOBILES.—Novelties at the Fifth Annual Paris Automobile Show.—7 illustrations..... 22899

IV. COMMERCE.—Trade Suggestions from United States Consuls... 22909

V. ELECTRICAL ENGINEERING.—Contemporary Electrical Science..... 22897
New Electric Railroad from Paris to Versailles.—5 illustrations.. 22904
On a New Process for Tuning Spark Telegraph Stations.—By Count ARCO.—8 illustrations..... 22898

VI. GEOGRAPHY.—Capt. Sverdrup's Explorations in Greenland... 22910

VII. GEODESY.—The French Geodetic Mission to the Equator.—3 illustrations..... 22896

VIII. MECHANICAL ENGINEERING.—History of Chain Testing..... 22898

IX. MEDICINE AND THERAPEUTICS.—Treatment of Disease by Ultra-Violet Rays.—By WILLIAM J. HAMMER. 22908
Utilization of Peanuts Medicinally..... 22901

X. MISCELLANEOUS.—Dromomania..... 22911
Trade Notes and Recipes..... 22910

XI. NAVAL ARCHITECTURE.—Improved Design of Screw Propulsion for Shallow-draft Boats.—5 illustrations..... 22907

XII. PHYSICS.—New Form of Radiation: Experiments of M. Blondlot..... 22901
On Electrons.—IV.—By Sir OLIVER LODGE, F.R.S.—2 illustrations..... 22895

XIII. SANITATION.—Heating and Ventilating of Railroad and Other Shops..... 22898

XIV.—TECHNOLOGY.—Utilization of the Pressed Residues of Olives..... 22910

XV. TRAVEL AND EXPLORATION.—Domestic Life in India.—By JOHN DAVID REES, C.I.E..... 22904

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-S ... 2206
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